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For convenience all presentations (oral and posters) include the presenter's name only.
Please refer to the Book of Abstracts for the full list of co-authors.
ECS stands for Early Career Scientist (their names are underlined).

Welcome

It is with great excitement that we welcome you to Lisbon for the international symposium on "*Small Pelagic Fish: New Frontiers in Science for Sustainable Management*." Populations of small pelagic fish in both marine and inland waters are crucial components of global food security, and they play an important role in the transfer of energy through food webs to top predators. The biomasses and distributions of these populations have exhibited dramatic variability in historical (and prehistorical) records, and there is growing concern for their resilience in the face of changing climate and unsustainable use. Global interest in the processes affecting the recruitment, ecology, assessment, and sensitivity to environmental and anthropogenic factors of small pelagic fish and in developing robust practices for their sustainable management motivates our efforts to understand the dynamics of these populations. Sharing our knowledge and making comparisons across regions are particularly important to advance the science and management of these resources.

We last came together for an international symposium in Victoria, Canada, in March of 2017. Research shared at the Victoria symposium composed special issues in *Deep-Sea Research Part II and Marine Ecology Progress Series*, and the engaging discussions spawned during that symposium revitalized the collaborative efforts that now gather us once again. Although that Victoria symposium was only five years ago, the world has changed in ways that were unimaginable at the time, stressing global food security, travel and shipping, global economies, and the open exchange of information across international borders. Perhaps because of these new challenges, we feel so privileged to be able to gather together again—from more than 40 countries around the world—for the development, discussion, and investigation of hypotheses concerning small pelagic fish.

During the last several years, substantial scientific progress has been made on understanding the drivers and dynamics of ecosystems across a range of spatial and temporal scales. The integration of numerical models with ever-growing data from monitoring efforts and stock assessments has enabled more comprehensive consideration of hypotheses describing population variability. Additionally, the rapid development of new methods such as eDNA, machine learning, and genome analysis to ascertain population structure can offer new insight to long-standing questions. The application of various regional management strategies and approaches to studying coupled social-ecological systems in collaboration with industry and other stakeholders is ripe for comparative research. We also recognize that populations of small pelagic fish are vital in inland waters as well as in the marine realm, and we are delighted to welcome those colleagues who bring perspectives on the dynamics of these fish in freshwater systems.

Another substantial development since the Victoria symposium is the launching of the United Nations Decade of Ocean Science for Sustainable Development, an ambitious effort to draw the global community together in a common framework to support the science necessary for sustainable development. We anticipate that our discussions this week will complement collaborative research conducted by the joint ICES/PICES Working Group on Small Pelagic Fish, inform and foster research efforts in other parts of the world, especially in developing countries, and ultimately advance the goals of the UN Decade as we seek to improve our understanding of these invaluable fish populations.

We thank the primary organizing institutions, PICES, ICES, and FAO, for their hard work in preparing this event, particularly given the ongoing challenges and uncertainties associated with travel and gatherings. We express our gratitude to the numerous sponsors, the local organizers at IPMA, and the Gulbenkian Foundation; without their generous support, this symposium would not have been possible. Our thanks go also to the Scientific Steering Committee and the session and workshop conveners and invited speakers for their commitment.

We look forward to an engaging week of discussions and hope that participants will share their enthusiasm and visions for advancing the science for sustainable management of small pelagic fish.

Symposium Convenors and Coordinators

Symposium Organizers

Symposium Convenors

Ignacio Catalán
(ICES), Mediterranean Institute for Advanced Studies (IMEDEA), CSIC-UIB, Spain

Susana Garrido
Portuguese Institute of Sea and Atmosphere (IPMA), Portugal

Myron Peck
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Ocean University of China, China

Workshop and Session Descriptions

Workshop 1: Application of Genetics to Small Pelagic Fish

Convenors:

Rita Castilho (corresponding)
(Centre for Marine Sciences (CCMAR), University of Algarve, Portugal)

Anna Verissimo
(Research Centre in Biodiversity and Genetic Resources (CIBIO), Portugal)

Jan McDowell
(Virginia Institute of Marine Science, USA)

Malika Chlaida
(National Institute for Fisheries Research, Morocco)

The scope of the 2022 SPF Symposium recognizes the recent developments of genetic-based methods such as eDNA and genome analysis and its contribution to clarify questions of stock/population structure, which are pivotal for integration on fisheries management advice. This workshop will introduce participants to a range of genetic and genomic tools that support the management of fishery resources and provide a critical assessment of costs and benefits. The workshop is designed to target a broad community of researchers, including those with some experience in genetics/genomics and those who are less familiar with these issues. Content and format will comprise an informal presentation on technical approaches, emphasizing case studies illustrating how genetics can help address fisheries' existing management and policy needs. Ideally, follow-up discussions will be based on a series of topical-driven questions.

We welcome works that use molecular genetics to address questions relevant to fisheries science, such as (but not exclusively) population genetics/genomic approaches to resolve stock structure, stock delineation, and connectivity estimates; monitoring the genetic diversity of exploited stocks; eDNA metabarcoding on stomach contents as an alternative approach to trophic ecology studies; molecular identification of fisheries products for forensic/traceability purposes; molecular assays for species identification (e.g. larval fish/eggs).

Workshop 2: The Devil's in the Details of Using Species Distribution Models to Inform Multispecies and Ecosystem Models

Convenors:

Isaac Kaplan (corresponding)
(Northwest Fisheries Science Center, NOAA, USA)

Elliott Hazen
(Southwest Fisheries Science Center, NOAA, USA)

Robert Wildermuth
Institute of Marine Sciences, University of California Santa Cruz, USA)

Stefan Koenigstein
(Southwest Fisheries Science Center, NOAA, USA)

Mariana Hill-Cruz
(GEOMAR Helmholtz Centre for Ocean Research, Germany)

Pierre-Yves Hernvann
(Northwest Fisheries Science Center, NOAA, USA)

Barbara Muhling
(Southwest Fisheries Science Center, NOAA, USA)

The ability to predict spatial distributions of small pelagic fish has advanced rapidly in recent years, with approaches such as generalized additive models, boosted regression trees, neural networks, and spatio-temporal approaches such as VAST and sdmTMB (Elith and Leathwick, 2009; Elith, Leathwick, and Hastie, 2008; Hazen et al., 2012; Muhling et al., 2020; Robinson et al., 2017; Thorson, 2019; Anderson, 2019). Benefits include improving our ability to map shifts in species ranges seasonally and over past decades, understanding the ocean conditions that drive these shifts, and predicting long-term spatial redistribution due to climate change. Efforts to project large-scale ecosystem shifts related to climate change have begun to couple these spatial distributions to complex multispecies and end-to-end-ecosystem models, enabling the incorporation of stock size, trophic interactions, and fishing effects on distribution. This type of model coupling is intuitively attractive, yet presents us with multiple decisions and approximations. This workshop will focus on identifying best practices for the detailed decisions ("the devil's in the details") required to couple the burgeoning field of species distribution models (SDMs) to more complex multispecies and end-to-end models such as Ecospace, Ecosim, Atlantis, OSMOSE, EcoOcean, and MICE models (Plagányi et al., 2014; Coll et al., 2020; Christensen and Walters, 2004; Fulton et al., 2011; Shin and Cury, 1999). We categorize these decisions as:

- Should the more complex models include foraging behavior or other searching behavior, or should they simply be forced by the SDM, or a blend of both?
- How to best handle cases when SDMs omit regions or seasons included within the complex models?
- What covariates should be included in the SDM versus the complex model, or both models? This includes environmental covariates, space, and the influence of small pelagic species' stock size on distribution.
- How can complex but non-spatial ecosystem models be forced or informed by SDMs? This includes potential shifts in species diets or fleet catchability, even if these are implicit proxies for spatial overlap.
- How can estimates of uncertainty from SDMs be incorporated within the more complex models, which are often computationally orders of magnitude slower?

We seek global expertise and solutions to these questions, particularly when considering long-term projections of species distributions and ecosystems under climate change. The anticipated product from the workshop will be a peer-reviewed manuscript summarizing the state of the art and emerging solutions for coupling SDMs to more complex multispecies and ecosystem models. This will include case studies from the California Current and Humboldt Current, but we invite broad participation and case studies from the PICES, ICES, and global community researching small pelagic species.

Workshop 3: Small Pelagics for Whom? Challenges and Opportunities for the Equitable Distribution of Nutritional Benefits

Convenors:

Molly Ahern (corresponding)
(Fisheries Division, Food and Agriculture Organization (FAO))

Nicole Franz
(Fisheries Division, Food and Agriculture Organization (FAO))

Maarten Bavinck
(University of Amsterdam, the Netherlands)

Shakuntala H. Thilsted
(WorldFish, Consultative Group on International Agricultural Research (CGIAR))

David Mills
(WorldFish, CGIAR)

Derek Johnson
(University of Manitoba, Canada)

Jeppe Kolding
(University of Bergen, Norway)

Small freshwater and marine fish, often consumed whole, are particularly rich in micronutrients and aid in the absorption of nutrients from plant-based foods with which they are commonly eaten. Small fish are still a relatively low-cost food in most countries of the world when compared to other animal-sourced foods, and can be purchased in small quantities, making them more accessible to the poor. This workshop will focus on the post-harvest aspects of small pelagics and explore their contribution to the food security and nutrition of poor and undernourished populations in the developing world through the sustainable food system framework (HLPE, 2020), particularly highlighting the role that small-scale fisherfolk play in access to small fish for food and nutrition security, and environmental, social and economic sustainability of food systems. The food system framework allows to expand the traditional value chain approach by looking at the availability, access, utilization, stability, and sustainability of small fish in food systems, addressing drivers, scales and levels, stakeholders, interactions, feedback and the multiple outcomes from food systems, including trade-offs such as the use of small fish for fish-based animal feeds. The workshop will address food security, nutrition and socio-economic aspects of the small pelagic post-harvest sector, focusing on questions such as:

- How are small pelagics embedded in local food cultures and what are the related socio-economic benefits?
- What is the impact of change in demand for small pelagics, in particular for fish meal production, on the equitable distribution of livelihood and nutritional benefits from these species?
- What is needed to ensure that small pelagics continue to contribute to equitable livelihoods and nutrition for the most vulnerable?

The workshop is expected to provide more insights on the nutritional value of small pelagic fish, especially for more vulnerable consumer groups, and on the distributional segment of small pelagic value chains, with a focus on Africa. It will consist in short presentations followed by with interactive group discussions and wrap-up by a group of experts.

This workshop is timely, being in the midst of the International Year for Artisanal Fisheries and Aquaculture (IYAFA, 2022), the UN Decade of Action on Nutrition (2016-2025), the UN Decade of Action on Ocean Science (2021-2030), and following the UN Food Systems Summit (2021).

Workshop 4: Evaluating Inter-Sectoral Tradeoffs and Community-Level Response to Spatio-Temporal Changes in Forage Distribution and Abundance

Convenors:

Felipe Quezada Escalona
(Southwest Fisheries Center, NOAA, USA)

Tim Frawley
(Institute of Marine Sciences, University of California Santa Cruz, USA)

Dorleta Garcia
(AZTI, Spain)

Isaac Kaplan
(Northwest Fisheries Science Center, NOAA, USA)

Juan Carlos Seijo
(School of Natural Resources, Universidad Marista, Mexico)

Stephen Stohs
(Southwest Fisheries Center, NOAA, USA)

(Pacific Islands Fisheries Science Center, NOAA, USA)

Desiree Tommasi (corresponding)
(Institute of Marine Sciences, University of California Santa Cruz, USA)

Robert Wildermuth
(Institute of Marine Sciences, University of California Santa Cruz, USA)

Small pelagic fish (SPF) exhibit large fluctuations in abundance and distribution in response to environmental variability, harvest, and predation pressure. Given their critical ecological role in transferring energy from the planktonic food web to higher trophic levels, such changes in SPF dynamics impact both directed fisheries on SPF, and other dependent predators, including commercially important finfish and protected species. It is therefore of interest to SPF fishery managers to evaluate tradeoffs between large-scale directed catch of SPF and their role in (1) supporting regional marine ecosystems as a forage base and (2) providing direct benefits to coastal communities as a source of livelihoods and nutrition. However, to maintain resilience of fishing communities and develop adaptation strategies to climate change, improved understanding of how fishers respond to spatio-temporal shifts in forage availability is also paramount. Fishers might have heterogeneous responses depending on local regulation, fleet sizes, industry structure, market institutions, and social norms. This workshop will highlight innovations and challenges in modeling responses of fishers and fishing communities to variability of SPF availability through a comparison of case studies of SPF fisheries around the world. We welcome contributions to methodological advances in integrated biological-economic models, ecologically informed economic models of fisher behavior, such as spatio-temporal fishing location models or multispecies discrete choice models, and models of fishing community response and adaptation to climate. We also encourage presentations highlighting approaches to modeling the economic and ecological tradeoffs inherent in SPF management, as well as approaches that focus on the heterogeneity in fishers' realities. The anticipated outcome of the workshop will be a synthesis manuscript highlighting best practices and challenges in modeling responses of fishers and fishing communities to SPF variability through a comparison of case studies of SPF fisheries around the world.

Workshop 5: Recent Advances in the Daily Egg Production Method (DEPM): Challenges and Opportunities

Convenors:

Andres Uriate (corresponding)
(Basque Research and Technology Alliance (BRTA), AZTI, Spain)

Tim Ward
(Institute of Marine and Antarctic Studies (IMAS), University of Tasmania, Australia)

Cristina Nunes
(Portuguese Institute of Sea and Atmosphere (IPMA), Portugal)

Luis Cubillos
(Universidad de Concepción, Chile)

Kostas Ganias
(Aristotle University of Thessaloniki, Greece)

Application of the Daily Egg Production Method (DEPM) to the assessment of pelagic fish populations has been expanding and being refined since its development for anchovy at the Southwest Fisheries Center in the 1980s (Parker, 1980; Lasker, 1985). Since then, it has been applied to many other fish species (e.g., sprat, sardines, mackerels, horse mackerels, snappers, etc.) in oceans all over the world (Alheit, 1993; Stratoudakis et al., 2006; Bernal et al., 2012). Several workshops have been conducted to share the progress in the application of the method (e.g., San Sebastián, Spain, Motos, 1997; Concepción, Chile, Castro et al., 2005; Athens, Greece, Dickey-Collas et al., 2012, Adelaide, Australia, Ward et al., 2015). During the last decade there have been several advances in estimation procedures for both egg production and adult parameters, as well as new insights into reproductive biology (Basilone et al., 2015; Claramunt et al., 2019; Charitonidou et al., 2020; Ferreri et al., 2016, 2019; Ganias and Lowerre-Barbieri, 2017; Ganias et al., 2018; McGarvey et al., 2018; Oxley et al., 2017; Ward et al., 2021). In addition, several studies have consolidated long-time series of data and provided new perspectives on the strengths and challenges of the DEPM for monitoring pelagic fishes (Santos et al., 2018; Angelico et al., 2018; Ward et al., 2021). This symposium offers a timely opportunity for scientists from around the world who are working on different aspects of the DEPM on different species in different ecosystems to gather to discuss their new findings, ongoing challenges and future opportunities. The methodological developments warrant presentations and face-to-face discussions among scientists working on this field in a workshop, while more general challenges and perspectives overviews of this and other direct methods would better fit into the Topic Session 5 of the symposium (Progress in Pelagic Surveys: From Biomass Estimates to Monitoring Ecosystems). Convenors of the workshop will liaise with convenors of the Topic Session to clarify what contributions would fit best in each forum.

The workshop will be carried out through oral presentations on recent methodological developments on the application of the DEPM in different regions. We call for some contributions on several topics listed below to focus the workshop discussions:

- Estimating daily egg production and mortality: ongoing challenges and potential solutions;
- Spawning area: can new approaches provide better estimates? What about precision?
- Late oocyte development and POFs resorption dynamics, spawning markers and improved estimations of spawning fraction: ongoing challenges and potential solutions;
- Three adult parameters or four: pros and cons of estimating Relative Fecundity as two separate parameters;
- Progress in estimation of spawning biomass, expansion to population by size and ages, spatial explicit procedures, precision and accuracy, and others.

The anticipated product from the workshop, in conjunction with the Topic Session 5, will be a special issue of a peer-reviewed journal. The intent is also to prepare a review/metanalysis paper. Consideration will be given to producing a white paper.

Workshop 6: Small Pelagic Fish Reproductive Resilience

Convenors:

Rosario Domínguez Petit (corresponding)
(Centro Nacional Instituto Español de Oceanografía (IEO-CSIC), Oceanographic Centre of Vigo, Spain)

Susan Lowerre-Barbieri
(School of Forest Resources and Conservation, University of Florida / Fish and Wildlife Research Institute, Florida Fish and Wildlife Conservation Commission, USA)

Leonardo Castro
(Departamento de Oceanografía / Centro COPAS Sur-Austral, Universidad de Concepción, Chile)

Akinori Takasuka
(Graduate School of Agricultural and Life Sciences, The University of Tokyo, Japan)

The reproductive resilience paradigm takes an eco-evolutionary perspective to identify species-specific traits in spawner-recruit systems that drive reproductive success and consequently resilience to fishing pressure. Although reproductive success is tightly coupled with adult abundance and fecundity in many terrestrial animals, in exploited marine fish where and when fish spawn, and consequent dispersal dynamics, may have a greater impact. To operationalize the use of the reproductive resilience paradigm to inform management requires increasing scientific dialogue across fields including fisheries ecologists, geneticists, early life biologists and stock assessment scientists. We need to move beyond the intrinsic population growth equation to understand drivers of transgenerational productivity. The objectives of the workshop are:

- draw on diverse scientific expertise to discuss advances in understanding drivers of reproductive success in SPF stocks and reproductive resilience as an indicator of population and marine ecosystem status for sustainable management of marine stocks and ecosystems;
- using the reproductive resilience paradigm to identify core factors in SPF as well as knowledge gaps and research and modeling needs;
- outline a draft for a special issue or review paper in SCR journal focused on reproductive resilience of SPF.

Furthermore, the workshop aims to create a networking environment for research on Fish Reproductive Resilience to be presented in funding calls (e.g. EU COST-Actions), which promotes collaboration among scientists working on fish reproductive resilience and related fields.

Session 1: Trophodynamic Processes

Convenors:

Susana Garrido (corresponding)
(Portuguese Institute of Sea and Atmosphere (IPMA), Portugal)

Richard Brodeur
(Oregon State University, USA)

Jana del Favero
(Management of the Ocean Decade, Brazil)

Francis Juanes
(University of Victoria, Canada)

Tatsuya Sakamoto
(Japan Fisheries Research and Education Agency (FRA), Japan)

Plenary Speaker:

Carl van der Lingen
(Department of Forestry, Fisheries and the Environment (DFFE), South Africa)

Invited Speaker:

Marta Albo-Puigserver
(Spanish Institute of Oceanography (IEO-CSIC), Oceanographic Centre of the Balearic Islands (COB), Spain)

Small pelagic fish (SPF) forage near the base of the food web in marine and inland waters. Changes in prey availability can have marked consequences on the productivity of populations of predators. Understanding environmental drivers of the dynamics of SPF populations, therefore, requires knowledge of the abiotic and biotic processes regulating SPF prey fields as well as robust estimates of diet and prey requirements. Moreover, top-down (predation) effects of SPF and their competitors may be just as important as bottom-up (abiotic) impacts in controlling the availability of prey. Future changes in predator–prey interactions depend on a complex array of individual factors affecting physiological rates and the strengths of associations between species. Although aspects of the trophodynamics of SPF have been studied for decades, gaps in knowledge still exist on important aspects of SPF diets, including prey quality requirements for the growth and survival of early life stages, ontogenetic diet shifts, and feedback between the changes in prey field dynamics and reproduction.

This session welcomes presentations on all aspects of trophodynamic processes involving SPF in marine and inland waters, particularly:

- The impact(s) of environmental drivers on the phenology, abundance and composition of key prey taxa, novel diet studies, and/or processes impacting rates of feeding, competition, and predation;
- Comparative studies focusing on trophic overlaps between SPF and other planktivorous species; especially, studies investigating climate-driven and/or density-dependent processes or the impacts of environmental drivers;
- Studies exploring novel techniques in the quantitative and qualitative analyses of SPF trophic ecology in marine and/or inland waters such as numerical modelling or molecular or biochemical techniques (e.g., from genetic, eDNA, fatty acid, or stable isotopic analyses).

Session 2: Life Cycle Closure: Advances in Process Understanding

Convenors:

Ignacio A. Catalán (corresponding)
(Mediterranean Institute for Advanced Studies (IMEDEA), Spain)

Noelle Bowlin
(Southwest Fisheries Science Center (SWFSC), NOAA Fisheries, USA)

Martin Huret
(French Research Institute for the Exploration of the Sea (IFREMER), France)

Motomitsu Takahashi
(Japan Fisheries Research and Education Agency (FRA), Japan)

Plenary Speaker:

Akinori Takasuka
(Fisheries Biology Laboratory, Graduate School of Agricultural and Life Sciences, the University of Tokyo, Japan)

Invited Speaker:

Laure Pecquerie
(Laboratory of Environmental Marine Sciences (LEMAR), French National Research Institute for Sustainable Development (IRD), France)

Intrinsic (individual-level physiology and population-level density-dependence) and extrinsic (environment, both abiotic and biotic) factors interact to shape time-varying changes in the small pelagic fish (SPF) abundance and/or distribution that can differ across life stages. This mechanistic understanding of how and why different life stages vary in space and time is a classical avenue of research that is now benefitting from the perspectives offered by new technologies, spanning from molecular techniques, new modelling approaches, and laboratory experiments exploring interacting pressures. This session encourages presentations that advance process understanding of SPF life cycle closure, with emphasis on spatial ecology and life history strategies. Studies that focus particularly on processes affecting early life stages, from eggs to juveniles (growth, connectivity, density-dependence, recruitment), as well as research on adult stages (e.g., maturation, fecundity, migration), are welcome.

This session invites contributions from marine and inland systems that particularly focus on:

- Spatially-explicit research with relevance for management, including individual-based modelling, trait analysis as linked to spatial dynamics, etc.;
- Studies on species/population acclimation (plastic response) or genetic adaptation based either on molecular, rearing or modelling experiments;
- Studies that compare traits (growth, reproduction and survival) and mechanisms (extrinsic, intrinsic) explaining life cycle closure and habitat utilisation/connectivity at different scales in space and time, in particular across regions or under different climate regimes.

Session 3: Understanding Population- and Ecosystem-level Shifts: From Seasonal Timing to Tipping Points

Convenors:

Rebecca Asch (corresponding)
(East Carolina University, USA)

Matthew Baker
(North Pacific Research Board, USA)

Jennifer Boldt
(Department of Fisheries and Oceans (DFO), Canada)

Patrick Polte
(Thünen Institute of Baltic Sea Fisheries, Germany)

Plenary Speaker:

Mary Hunsicker
(Northwest Fisheries Science Center (NWFSC), NOAA, USA)

Invited Speaker:

Joël Durant
(Centre for Ecology and Evolution Synthesis (CEES), University of Oslo, Norway)

The responses of fish stocks to changing environmental conditions can have impacts at various time scales with consequences for a broad range of population characteristics. Although we strive to predict shifts in phenology and spatial distribution, such changes can also complicate efforts to understand the relationships between fish populations and environmental forcing, challenging our ability to predict future changes. Further hindering our efforts is the fact that the strengths of relationships among environmental drivers and population traits often change over time. These non-stationarities, both at the level of fish stocks and in a broader ecosystem context, are exemplified by tipping points between ecological regimes and/or rapid shifts in species dominance. These changes could be due to extrinsic factors linked to climate variability and atmospheric forcing, and/or intrinsic factors such as changes in animal behaviour or adaptation to new conditions. The consistency of shifts across ecosystems and regions is a harbinger of global-level threats to the resiliency of populations and ecosystems. This session aims to explore resilience in the context of non-stationarity (e.g., tipping points, shifts in inter-specific relationships, phenological mismatches between trophic levels, non-linear reactions to environmental forcing), both at the level of stocks and in a broader ecosystem context. In this context, defining and evaluating resilience becomes an important consideration, both for stocks and for fisheries.

This session encourages presentations that intend to understand the spatio-temporal variability in small pelagic fish (SPF) using one or several of the following approaches:

- Re-analyses or short-term forecasts of phenological shifts in key aspects of life cycles such as spawning or migration;
- Novel strategies to evaluate shifts in phenology, including assessment of the oceanographic, biogeochemical, or ecological drivers;
- The relationship between SPF and ecosystem-level tipping points;
- Perspectives on ways to define, evaluate, monitor, and promote stock and fishery resilience in the context of stock movement and boom-and-bust dynamics and in the context of the resilience of ecological functions.

Session 4: Responses to Climate Variability and Change at Decadal to Centennial Time Scales

Convenors:

Ryan Rykaczewski (corresponding)
(Pacific Islands Fisheries Science Center (PIFSC), NOAA Fisheries, USA)

Dimitri Gutierrez
(Marine Institute of Peru (IMARPE), Peru)

Haruka Nishikawa
(Japan Agency for Marine-Earth Science and Technology (JAMSTEC), Japan)

Renato Salvatteci
(Center for Ocean and Society, Kiel University, Germany)

Plenary Speaker:

Renato Salvatteci
(Center for Ocean and Society, Kiel University, Germany)

Invited Speaker:

Michinobu Kuwae
(Center for Marine Environmental Studies, Ehime University, Japan)

Various strategies have been applied to resolve the impacts of climate and oceanographic conditions on populations of small pelagic fish (SPF). Sediment records, acoustic surveys, ichthyoplankton collections, fisheries landings, modelling experiments, and other fisheries-dependent and independent data provide some insight regarding the responses of fish populations to changes in the environment. However, each of these methods has caveats regarding the time and spatial scales that it can accurately address. Hypotheses developed through examination of historical landings records can be substantially different from those developed through investigation of sedimentary records. Similarly, because patterns of large-scale climate variability can have ecosystem impacts that differ in intensity among and within regions, examination of oceanographic data collected at local scales can provide perspectives divergent from those offered by consideration of basin-scale conditions. Reconciling the different (and sometimes contrasting) perspectives offered by various methods remains a challenge. Our understanding of population responses to climate conditions may benefit from multi-disciplinary approaches that appreciate this scale dependency and the potential for non-stationarity among relationships through time. Linking knowledge of species' ecologies (e.g., recruitment, growth, feeding, distribution, migration, and spawning) with descriptions of changing environments by using both conceptual and numerical models can further help to resolve species' sensitivities to climate variability and change.

This session welcomes presentations that:

- Use information from multi-disciplinary approaches to better resolve the responses of SPF species to climate variability during paleo, observational, and future time periods;
- Highlight divergent perspectives and propose hypotheses that might reconcile differing views;
- Recognize that relationships among SPF populations and environmental conditions may be non-stationary across periods or when viewed at different spatio-temporal scales;
- Discuss of how insight offered by paleo and observational records can be applied to better project SPF population responses to future anthropogenic climate change.

Session 5: Progress in Pelagic Surveys: From Biomass Estimates to Monitoring Ecosystems

Convenors:

Maria Manuel Angélico (corresponding)
(Portuguese Institute of Sea and Atmosphere (IPMA), Portugal)

Chris Rooper
(Department of Fisheries and Oceans (DFO), Canada)

Jeroen van der Kooij
(Centre for Environment, Fisheries and Aquaculture Science (CEFAS), UK)

Tim Ward
(Institute of Marine and Antarctic Studies (IMAS), University of Tasmania, Australia)

Plenary Speaker:

Noelle Bowlin
(Southwest Fisheries Science Center (SWFSC), NOAA, USA)

Invited Speaker:

Tim Ward
(Institute of Marine and Antarctic Studies (IMAS), University of Tasmania, Australia)

Directed surveys are a crucial part of monitoring and scientific assessment of small pelagic fish (SPF). Acoustic, egg, and larval survey programs have been conducted on a wide range of SPF species in many regions of the world since the 1970s. Early fisheries surveys often focused on a single target species with limited information collected on the physical environment and other pelagic ecosystem components. Vast technological advances and increased recognition of the need for robust advice to inform fisheries management on environmental drivers, including climate change, have resulted in improvements in survey methodologies. Modern surveys are increasingly becoming holistic enterprises that deliver a comprehensive set of in situ observations on different biological, physical, and chemical components of the pelagic ecosystem. Together with sophisticated modelling approaches and remotely sensed data, surveys are providing important new insights on the structure and function of pelagic ecosystems. The design and outputs of surveys vary according to their purpose and depend on the platforms, equipment, and expertise available. These differences hamper robust comparisons of SPF dynamics among ecosystems. Moreover, information from fisheries may be an important supplement to information gained from traditional surveys. It is becoming increasingly important that information and products from all parts of the survey process are shared with all stakeholders (from other researchers, the industry, to the broader community). This transparency ensures that survey methodologies are developed within a quality assurance framework that meets both accreditation criteria and community expectations regarding access to knowledge derived from publicly-funded research.

This session invites presentations on all aspects of surveys targeting pelagic fish species in marine and inland waters, including:

- New technologies, approaches (e.g., survey design, data processing, autonomous vehicles) and products;
- Biomass estimation – improving accuracy and precision, alternative indicators of stock status, use in stock assessments;
- Climate change-induced challenges to survey design and products;
- Incorporation of industry data to supplement traditional survey data;
- Ecosystem-based approaches, integrated monitoring, modelling, survey products for ecosystem assessment.

Session 6: Reconciling Ecological Roles and Harvest Goals: Development and Testing Management Strategies to Enhance Marine Ecosystem Services

Convenors:

Sarah Gaichas
(Northeast Fisheries Science Center (NEFSC), NOAA Fisheries, USA)

Cecilie Hansen
(Institute of Marine Research (IMR), Norway)

Isaac Kaplan (corresponding)
(Northwest Fisheries Science Center (NWFSC), NOAA Fisheries, USA)

Richard Nash
(Centre for Environment, Fisheries and Aquaculture Science (CEFAS), UK)

Plenary Speaker:

Carryn de Moor
(University of Cape Town, South Africa)

Invited Speaker:

Amy Schueller
(Southeast Fisheries Science Center (SEFSC), NOAA, USA)

Ecosystem-based fisheries management plans for small pelagic fish (SPF) must often reconcile the role of these species in marine and inland food webs as well as their economic and social value as a harvested resource. Natural, environmentally driven fluctuations in SPF pose an additional challenge to the sustainable use and management of SPF production. In this session, we welcome presentations regarding management approaches that help ensure sustained ecosystem services from marine and inland SPF stocks, including both harvest and forage provision for predators. In addition, ecosystem modelling and management strategy evaluations that allow testing new approaches, such as spatial management, improved monitoring and recruitment forecasts, or alternative harvest strategies, are encouraged. One goal of the session is to identify success stories from particular regions, with careful consideration about how that success can be replicated.

The session hopes to attract studies addressing:

- Approaches that can integrate long-term climate change and short-term environmental variability into management and whether/how these approaches differ;
- Trade-offs between assuring ecosystem needs of predators versus yields of SPF, and performance indicators and reference points representing these trade-offs;
- Quantifying the dynamic role of SPF within the ecosystem, and inter-annual changes in dominant populations drivers (e.g., fishing versus climate drivers);
- The utility of ecosystem models to evaluate multiple drivers of fish stocks and/or test management strategies and the best practice of using ecosystem models (e.g., quantifying ranges of uncertainty, measuring model skill, and including information into assessment and management);
- Assessing and managing fluctuating stocks of SPF in data-limited situations;
- Integrating indicators and ecosystem data, coming either from direct monitoring from the fishing industry or from surveys, into SPF management and related ecosystem modelling.

Session 7: Advancing Social-ecological Analyses and Sustainable Policies for Human Communities Dependent on SPF

Convenors:

Tarûb Bahri
(UN Food and Agriculture Organization (FAO))

Maria Gasalla
(University of Sao Paulo, Brazil)

Mitsutaku Makino
(University of Tokyo, Japan)

Myron Peck (corresponding)
(Royal Netherlands Institute for Sea Research (NIOZ), the Netherlands)

Plenary Speaker:

Elena Ojea
(CIM-Universidade de Vigo, Spain)

Invited Speaker:

Dimitri Gutiérrez
(Peruvian Institute of Marine Research (IMARPE), Peru)

Small pelagic fish (SPF) represent an essential source of highly nutritious food, particularly for the poorer and more vulnerable segments of society, and support livelihoods, including for women involved in post-harvest activities in developing countries. Moreover, SPF form the most commercially important fisheries resources globally. There is a constant and dynamic evolution of SPF fisheries to adapt to and respond to external drivers such as climate change and market demand, but a number of gaps in quantitative and qualitative knowledge exist on SPF fisheries at all levels: ecological, social, and economic. Science-based advice for management, therefore, requires not only information on the drivers of the natural dynamics of SPF (e.g., productivity regimes), but also on societal needs and requirements (e.g., economic and/or cultural). Considering the increasing momentum on sustainability (Sustainable Development Goals, FAO Declaration on Fisheries Sustainability), this session takes stock of progress made in the use and management of SPF, including demonstrating how new technologies and tools fill knowledge gaps in the context of global change. The session also invites presentations on how information has been gathered from dependent human communities and used to advance various social-ecological analyses. The session is expected to have a strong focus on marine and inland small-scale fisheries, SDG 14.b (access for small-scale artisanal fishers to marine resources and markets), and to contribute to the generation of knowledge that will inform the International Year of Artisanal Fisheries and Aquaculture (IYAFA) that will be celebrated in 2022.

This session welcomes presentations on SPF in marine and inland waters that:

- Quantify and characterize the reliance of coastal communities on SPF for nutrition, food security, and employment;
- Advance management and governance arrangements (e.g., management plans, implementation of Ecosystem Approach to Fisheries, regional approaches) impacting access to SPF resources;
- Examine access to markets including recent trends in processing, marketing and use of SPF (e.g. inter-regional and international fish markets, reduction for feed, changes in value chains);
- Report on climate vulnerability/risk assessments, adaptation measures, and strategies focused on SPF throughout the value chain as well as economic tipping points.

Notes for Guidance

LOCATION

Conference Center, Calouste Gulbenkian Foundation (Av. de Berna, 45A, 1067-001 Lisbon, Portugal).
(*https://gulbenkian.pt/en/the-foundation/*)
As one of local sponsors, the Foundation generously provides their meeting facilities free of charge.

REGISTRATION

The Registration desk will be open in the Main Lobby, all days (08:00-18:00).

PRESENTATIONS

In order to allow the sessions to run smoothly, and in fairness to other speakers, please note that all presentations are expected to adhere strictly to the time allocated. Unless specified by Convenors, authors should designate at least 3 minutes for questions. Authors can upload their presentations directly to the computers where the sessions/workshops will be held.

Important: **Please rename your files - time-name.ppt** (*e.g.* 0900-Smith.ppt, 1530-Kim.ppt).

POSTERS

All posters will be on display in Sala 2 and adjacent Hall for the entire duration of the Symposium, **November 8-11**. Poster presenters are expected to be available near their poster to answer questions during the Evening Poster Session/Reception from 18:00–20:00 on Wednesday, November 9. All posters have to be removed during Lunch on Friday, November 11.
On **November 7**, workshop posters will be on display in the workshops' rooms.

SPECIAL EVENTS

Mentoring Event for Early Career Scientists

November 8 (18:15-19:30)
Conference Center, *Calouste Gulbenkian Foundation, Sala 1*

During this event, early career scientists will have the opportunity to interact with mentors who have expertise across diverse geographic regions, research disciplines, and career-related areas. Mentors include members of the symposium's organizing and scientific steering committees, plenary and invited speakers, and topic session and workshop conveners. The event will be split into two sessions (25-30 minutes each), with participants rotating once to different (informal) discussion groups.

Photo Exhibition

November 7-11 (all day)
Conference Center, *Calouste Gulbenkian Foundation, Main Lobby*

This exhibition captures some history and traditions of small pelagic fishery in Portugal.

Documentary on sardine fishery in Portugal

November 7-11 (all day)
Conference Center, *Calouste Gulbenkian Foundation, Main Lobby*

The documentary "Portuguese Sardine - A Natural Wealth" (Authors: Joaquim Pedro Ferreira and Bruno Pinto; Directors: Pedro Miguel Ferreira, Joaquim Pedro Ferreira) was produced for the National TV in 2022. It focuses on one of the Portuguese national treasures – sardines, and ways to ensure the sustainability of populations of the species. This film (duration: 51 min) will be demonstrated on a large LCD screen located near the Secretariat Room.

SOCIAL ACTIVITIES

Welcome Reception

November 7 (19:00-21:00)
Quinta da Pimenteira (https://www.quintadapimenteira.pt/)

Quinta da Pimenteira is an old 18th century manor house located in the heart of the Monsanto Forest Park. Surrounded by several gardens and green spaces, Quinta da Pimenteira is located in the area of the Lisbon greenhouses, next to the Águas Livres Aqueduct.

Buses will leave from the Symposium venue at 18:30–18:40.

Poster Session Reception

November 9 (18:00-20:00)
Conference Center, *Calouste Gulbenkian Foundation (Sala 2 and adjacent Hall)*

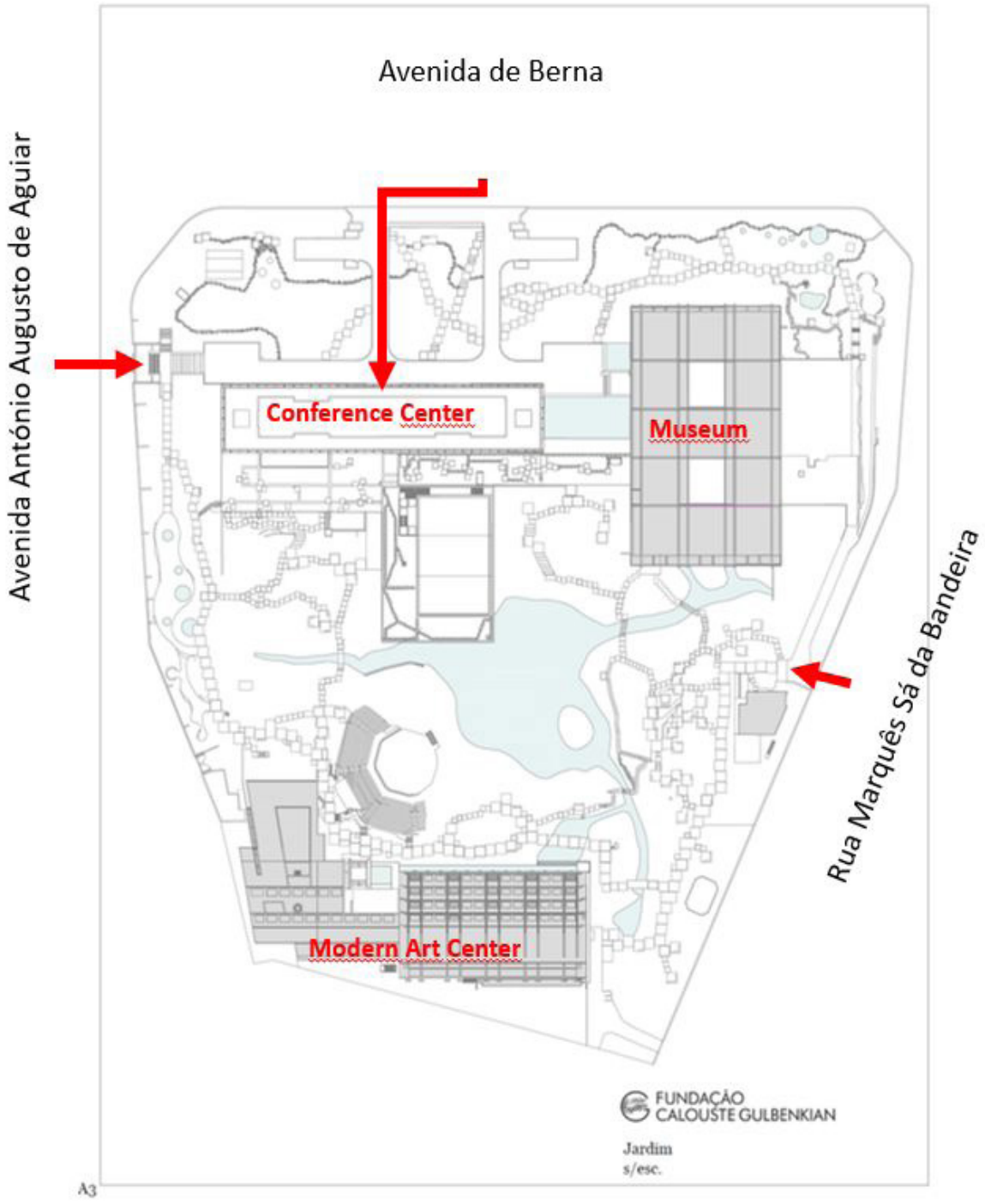
The modernist complex of buildings that includes the Foundation's headquarters, the Gulbenkian Museum and the surrounding garden was awarded the 1975 Valmor Prize and was considered a National Monument in 2010, becoming the first contemporary work to be part of the Portuguese national heritage.

Symposium Dinner

November 10 (18:00-22:00)
Pátio da Galé (https://www.silvacarvalhocatering.com/en/venues/Pateo-da-Gale/165/)

The Pátio da Galé, which opened in 2011, is located in the west wing of the Terreiro do Paço (The Palace Square), where the Royal Palace and the Casa da India stood before the earthquake of 1755 struck. This amazing venue benefits from a perfect historical environment in the heart of the city.

Floor plan


Avenida de Berna
Avenida António Augusto de Aguiar
Rua Marquês Sá da Bandeira
Conference Center
Museum
Modern Art Center
FUNDAÇÃO CALOUSTE GULBENKIAN
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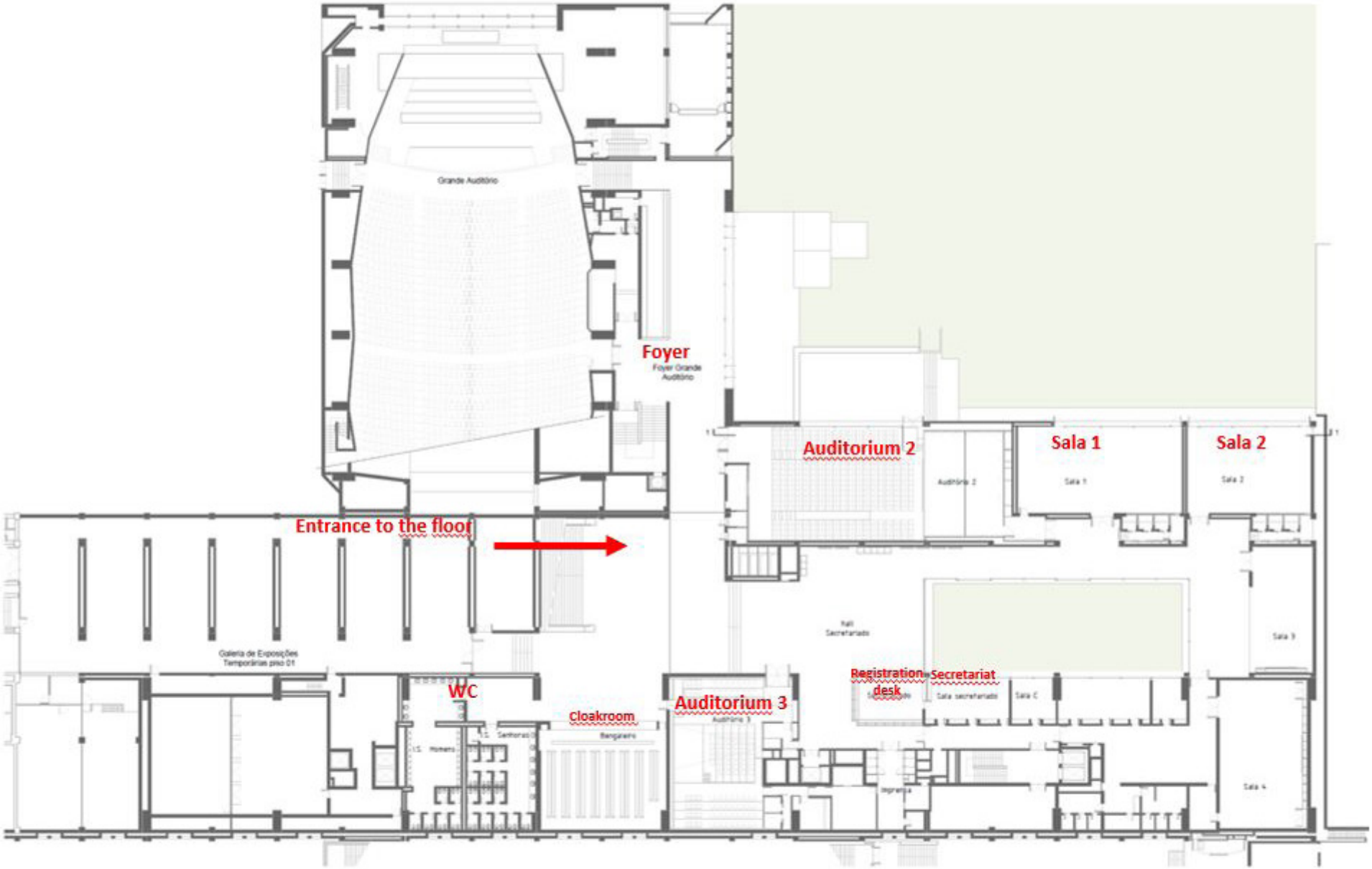

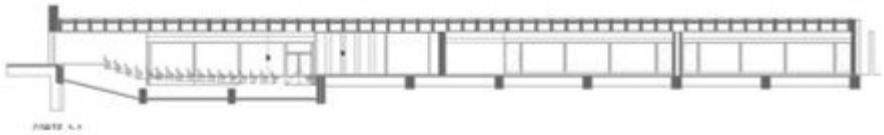

FUNDAÇÃO CALOUSTE GULBENKIAN

Zona de Congressos
esc: 1/200

List of Sessions and Workshops

S1	Nov. 10-11	Trophodynamic Processes
S2	Nov. 8-9	Life Cycle Closure: Advances in Process Understanding
S3	Nov. 8-9	Understanding Population- and Ecosystem-level Shifts: From Seasonal Timing to Tipping Points
S4	Nov. 10-11	Responses to Climate Variability and Change at Decadal to Centennial Time Scales
S5	Nov. 10-11	Progress in Pelagic Surveys - from Biomass Estimates of Small Pelagic Fish to Monitoring Ecosystems
S6	Nov. 9-10	Reconciling Ecological Roles and Harvest Goals: Development and Testing Management Strategies to Safeguard Marine Ecosystem Services
S7	Nov. 8	Advancing Social-ecological Analyses and Sustainable Policies for Dependent Human Communities
W1	Nov. 7	Application of Genetics to Small Pelagic Fish
W2	Nov. 7	The Devil's in the Details of Using Species Distribution Models to Inform Multispecies and Ecosystem Models
W3	Nov. 7	Small Pelagics for Whom? Challenges and Opportunities for the Equitable Distribution of Nutritional Benefits
W4	Nov. 7	Evaluating Inter-Sectoral Tradeoffs and Community-Level Response to Spatio-Temporal Changes in Forage Distribution and Abundance
W5	Nov. 7	Recent Advances in the Daily Egg Production Method (DEPM): Challenges and Opportunities
W6	Nov. 7	Small Pelagic Fish Reproductive Resilience

General Schedule

Monday, November 7			
09:00 13:10	**Workshop 1** [Auditorio 3, Break 10:50-11:10]	**Workshop 2** [Auditorio 2, Break 10:50-11:10]	**Workshop 5** [Sala 1, Break 10:50-11:10]
14:20 18:20	**Workshop 3** [starts at 14:00] [Auditorio 3, Break 15:55-16:15]	**Workshop 4** [Auditorio 2, Break 16:10-16:30]	**Workshop 6** [Sala 1, Break 16:00-16:20]
19:00 21:00	**Welcome Reception** [Quinta da Pimenteir, buses leave at 18:30-18:40 from Symposium venue]		
Tuesday, November 8			
09:00 12:40	**Opening Ceremony, Plenary Session** [Auditorio 2, Coffee/Tea Break 10:50-11:10, Lunch 12:40-14:00]		
14:00 18:00	**Session 3 (Day 1)** [Auditorio 2, Break 15:50-16:10]	**Session 2 (Day 1)** [Auditorio 3, Break 15:50-16:10]	**Session 7 (Day 1)** [Sala 1, Break 15:50-16:10]
18:15 19:30	**Early Career Scientist Mentoring Event** [Sala 1]		
Wednesday, November 9			
09:00 11:00	**Plenary Session** [Auditorio 2, Coffee/Tea Break 11:00-11:20]		
11:20 18:00	**Session 3 (Day 2)** [Auditorio 2, Break 15:40-16:00]	**Session 2 (Day 2)** [Auditorio 3, Break 15:40-16:00]	**Session 6 (Day 1)** [Sala 1, Break 15:40-16:00]
18:00 20:00	**Poster Session / Reception** [Sala 2 and adjacent Hall]		
Thursday, November 10			
09:00 10:30	**Plenary Session** [Auditorio 2, Coffee/Tea Break 10:30-10:50]		
10:30 18:20	**Session 1 (Day 1)** [Auditorio 2, Break 15:40-16:00]	**Session 5 (Day 1)** [Auditorio 3, Break 15:40-16:00]	**Session 6 (Day 2)** [Sala 1, 10:50-13:20] **Session 4 (Day 1)** [starts at 14:00] [Sala 1, Break 15:50-16:10]
19:00 22:00	**Symposium Dinner** [Pátio da Galé]		
Friday, November 11			
09:00 13:00	**Session 1 (Day 2)** [Auditorio 2, Break 10:40-11:00]	**Session 5 (Day 2)** [Auditorio 3, Break 10:40-11:00]	**Session 4 (Day 2)** [Sala 1, Break 10:40-11:00]
13:00	**Lunch**		
14:30 17:00	**Plenary Session, Closing Ceremony** [Auditorio 2]		

Registration All Days (08:00-18:00), main lobby area

Coffee/Tea Breaks will take place every day in the morning and afternoon

Lunch is scheduled approximately from 12:40-14:00 (check detailed schedules)

Workshops W1, W2, W5 Schedules, November 7

W1 [Auditorio 3] *Application of Genetics to Small Pelagic Fish*		**W2** [Auditorio 2] *The Devil's in the Details of Using Species Distribution Models to Inform Multispecies and Ecosystem Models*		**W5** [Sala 1] *Recent Advances in the Daily Egg Production Method (DEPM): Challenges and Opportunities*	
9:00	**Introduction by Convenors**	9:00	**Introduction by Convenors**	9:00	**Introduction by Convenors**
9:05	**Jan R. McDowell** From allozymes to eDNA: An overview of molecular methods	9:10	**Participants introductions**	9:10	**Richard McGarvey** Alternative methods for estimating total daily egg production
		9:20	**Pierre-Yves Hernvann** Integration of species distribution models into Atlantis end-to-end models: Should fish stay or should fish go? …and other distribution parameters	9:20	**Leire Citores** A Bayesian estimation of daily egg production: Application to sardine in the Bay of Biscay
				9:30	**Leire Ibaibarriaga** Towards spatial-explicit daily egg production estimates
9:40	**Malika Chlaida** From allozymes to neutral molecular markers: Population genetics of sardines and anchovies	9:40	**Mariana Hill-Cruz** Habitat impact on the interannual variability of fish in the northern Humboldt Current System	9:40	**Luis Cubillos (*recorded*)** Spatial effects of daily egg cohort on the daily egg production rate of anchovy and common sardine off central-southern Chile
				9:50	**Luis Cubillos (*recorded*)** The precision of daily egg production and mortality rates: The importance of weighting by egg aggregation indices of the daily cohort
10:15	**Ana Veríssimo** The potential of Next-Generation-Sequencing: From genes to genomes, and from single to multiple markers	10:00	**Ricardo Oliveros-Ramos** Realized vs. Fundamental Niche SDMs for the coupling with complex multispecies and ecosystem models: The OSMOSE model as case example	10:00	**Alex R. Ivey** Precision of P_0; Insights from simulation modelling and field experiments
				10:10	**Maria Manuel Angélico** Egg production estimation for Atlantic Iberian sardine using CUFES sampling. Implementation of a biophysical model to assess the egg vertical density distribution
		10:20	**Criscely Luján** Understanding the impact of the spatial distribution of fish in the ROMS-PISCES-OSMOSE model for the Peru Current Upwelling Ecosystem: Insights from a sensitivity analysis of model forcings	10:20	**Gretchen L. Grammer** How precise are estimates of spawning area and spawning biomass of sardine off southern Australia?
		10:40	**Insights from presented case studies**	10:30	**Common discussion on Methods of Egg Production Estimates**
10:50	***Coffee/Tea Break***	10:50	***Coffee/Tea Break***	10:50	***Coffee/Tea Break***

Workshops W1, W2, W5 Schedules (cont.), November 7

W1 Continued [Auditorio 3]		**W2 Continued** [Auditorio 2]		**W5 Continued** [Sala 1]	
11:10	**Rita Castilho** Small pelagic fish genomics: How far have we gone?	11:10	**Jung Jin Kim (poster)** Understanding the distribution and transport processes for the early life stages of Todarodes pacificus, Scomber japonicus, Trichiurus japonicus using behavioral-hydrodynamic modeling approaches	11:10	**Common discussion on Methods of Egg Production Estimates**
		11:15	**Breakout Groups Introduction or Discussion**		
		11:25	**Breakout Group or General Discussion** (includes identification of additional potential case studies)	11:25	**Timothy Ward** Combining two parameters increases precision: Benefits of replacing batch fecundity and female weight with relative fecundity
				11:35	**Andrés Uriarte** Insights on F/W from "DEPM BIOMAN survey series in the Bay of Biscay: Lessons learned after 35 years of tracking the anchovy population in its ecosystem"
11:45	**Florian Berg** From genome assembly to fisheries assessment: A case study of Atlantic herring			11:40	**Katerina Charitonidou** Estimating spawning interval as the ratio of oocyte growth period to the number of oocytes cohorts
				11:50	**Andrei Makarchouk** Calculations of spawning-stock biomass of sprat in the Gotland Basin of the Baltic Sea with the DEPM in the years 2019-2021
12:00	**M. Pilar Cabezas** Range-wide genetic stock delineation of the European sardine (*Sardina pilchardus*) using whole genome sequencing (Pool-Seq)	12:00	**Report back and discussion of synthesis paper outline**	12:00	**Common discussion on F & W or on a combined param. (F/W) and on estimation of S and SSB**
12:15	**Jéssica F. R. Coelho** Combining ecologic and genomic modeling to inform sustainable management of fisheries stocks in a tropical sardine			12:20	**Dolores Garabana** Challenges in NE Atlantic Mackerel DEPM implementation
				12:25	**Paula Alvarez Jorna** The implementation of the DEPM in Western Horse mackerel during the Triennial mackerel and horse mackerel surveys (MEGS): pros and cons

ECS underlined

Workshops W1, W2, W5 Schedules (cont.), November 7

W1 Continued [Auditorio 3]		**W2 Continued** [Auditorio 2]		**W5 Continued** [Sala 1]	
12:30	**Naiara Rodriguez-Ezpeleta** A genetic toolkit to better understand small pelagics and their interactions with the ecosystem	12:30	**Concluding Remarks and Next Steps**	12:30	**Cristina Nunes** DEPM surveys and spawning behaviour of horse mackerel (*Trachurus trachurus*) from the Atlantic Iberian-southern stock (ICES 9a)
	Poster presentations			12:35	**Common discussion on application of DEPM on Mackerel and horse mackerel**
12:45	**Edmund Kajuni** A morphological and phylogenetic investigation of tilapiine fishes of the genus oreochromis in Southern Tanzania				
12:48	**Joana I. Robalo** Genclim – a project on the evolutionary and socio-economic consequences of shifting distribution ranges in commercially exploited marine fishes			12:50	**Closing the workshop and follow-up initiatives**
12:51	**María-Eugenia López** Lack of panmixia of Gulf of Bothnia vendace - Implications for fisheries management				
12:54	**Wrap up**				
13:10	**Workshop 1 Ends**	13:00	**Workshop 2 Ends**	13:00	**Workshop 5 Ends**

ECS underlined

Workshops W3, W4, W6 Schedules, November 7

W3 [Auditorio 3] *Small Pelagics for Whom? Challenges and Opportunities for the Equitable Distribution of Nutritional Benefits*		**W4** [Auditorio 2] *Evaluating Inter-Sectoral Tradeoffs and Community-Level Response to Spatio-Temporal Changes in Forage Distribution and Abundance*		**W6** [Sala 1] *Small Pelagic Fish Reproductive Resilience*	
14:00	**Introduction by Convenors**				
14:10	**Part 1: The poor consumer's perspective** A contextualized understanding of small fish consumption **Kyana Dipananda** (Leader)	14:20	**Introduction by Convenors**	14:20	**Introduction by Convenors**
14:25	**Part 2: Contribution of small fish to nutrition** Marian Kjellevold and Molly Ahern (Leaders)	14:25	**Felipe Quezada Escalona** Portfolio substitution between coastal pelagic species under shifting target species distributions and policy constraints	14:25	**Sue Lowerre-Barbieri** The reproductive resilience paradigm: Integrating behavior and feedback loops into understanding productivity and resilience in marine fish
14:40	**Theophilus Annan** (*recorded*) Heavy metals ingestion via consumption of *Engraulis encrasicolus*, *Sardinella aurita* and *Sardinella maderensis* from the coast of north-western and southern Africa: Implication for human risk			14:35	**Alba Jurado-Ruzafa** Monitoring programme of the Canary small pelagic fish (Spain, NW Africa) in the Spanish Data Collection Framework
14:45	**Richard Stephen Ansong** Potential contribution of micronutrients and fatty acids of small pelagic fish species to food and nutrition security among vulnerable groups	14:45	**Gonçalo Araújo** Investigating Portugal's mainland purse seine fishery spatiotemporal activities footprint based on georeferenced data	14:45	**Mathieu Doray** Combination of Continuous Underwater Fish Egg Sampler and acoustic data for estimating and mapping fish daily fecundity
14:50	**Reflection / Discussion Part 1 and 2** Marian Kjellevold and Molly Ahern (Leaders)			14:55	**Antonio Cuba** Reproductive behavior of north-center Peruvian anchovy *Engraulis ringens* stock from Peru during El Niño and La Niña events categorized by reproductive index anomalies, 1992-2020 **Antonio Cuba** Chages in the reproductive behavior and critical values of peruvian anchovy *Engraulis ringens* of north-center stock of Peru, determined as of their reproductive index patterns, 1992-2020

Workshops W3, W4, W6 Schedules (cont.), November 7

W3 Continued [Auditorio 3]		**W4 Continued** [Auditorio 2]		**W6 Continued** [Sala 1]	
		15:05	**Xiurou Wu** Spatial-dynamic model of commercial fisher's trip decision-making		
15:10	**Part 3: Trade and marketing of small fish** Holly Hapke and Ragnhild Overa (Leaders)			15:10	**Katja Mäkinen** Associations between egg quality, female traits and abiotic factors: Insights from 40-year-long Baltic herring monitoring program
				15:20	POSTERS Introduction and 3-min posters presentations **Katja Mäkinen (3 min)** Effects of maternal phenotype on egg quality in the Baltic herring at two temperatures **Aarne Lauerma (3 min)** The effects of maternal thyroid hormones on the egg size, hatching success and larval properties of the Baltic herring (*Clupea harengus membras*) in the Baltic Sea **Isabel Riveiro (3 min)** Drivers of the short-term changes of reproductive potential in *Scomber scombrus* and *Sardina pilchardus* in the North Iberian Peninsula waters
15:25	**Part 4: The role of processors and processing** Derek Johnson (Leader)	15:25	**Dorleta Garcia** Historical perspective and modeling of Spanish inshore fishery dynamics in relation to changes in abundance of small pelagic species		
15:40	**Anderson K. Ahwireng** Towards urban food security and nutrition in Ghana: The role of small pelagic fish value chains			15:30	**S. Lowerre-Barbieri** State of the Art. What has been done so far, and what has been left to be done?
15:45	**Lilian Joshua Ibengwe** Regional trade integration and its relation to income and inequalities among Tanzanian marine dagaa fishers, processors and traders				
15:50	**James Robinson** Small pelagic fish are the cheapest nutritious food caught in wild fisheries globally				
15:55	***Coffee/Tea Break***			16:00	***Coffee/Tea Break***

Workshops W3, W4, W6 Schedules (cont.), November 7

W3 Continued [Auditorio 3]		**W4 Continued** [Auditorio 2]		**W6 Continued** [Sala 1]	
		16:05	Insights from presented case studies		
		16:10	***Coffee/Tea Break***		
16:15	**Reflection / Discussion Part 3 and 4** Holly Hapke and Ragnhild Overa (Leaders)				
16:35	**Part 5: The effects of ecosystem and fishing on nutrition** Jeppe Kolding (Leader)	16:30	**Breakout Discussion** (small groups, includes identification of additional potential case studies)	16:20	**Akinori Takasuka** Identifying key topics. What do you think will be key-issues to be solved?
16:50	**Part 6: Governance of small fish food systems** Maarten Bavinck and Nicole Franz (Leaders)			16:50	**L. Castro** Potential Data Souces. What surveys, analyses, etc. are available and will be required for a future breakthrough?
17:05	**Alexandra Pounds** Community-based fisheries management in Bangladesh supports nutrition security				
17:10	**Reflection / Discussion Part 5 and 6** Maarten Bavinck and Nicole Franz (Leaders)			17:20	**R. Domínguez-Petit** Addressing the challenge. Any concrete study designs or collaboration ideas to clear the issues? Definition of Terms of reference for future actions?
17:30	POSTERS Introduction and 3-min posters presentations **Salvador E. Lluch-Cota** 15 years of evolution of the Gulf of California small pelagics fishery MSC certification **Atabak M. Azad (3 min)** Health effects, nutrients and contaminants availability from consumption of mesopelagic species in C57BL/6J mice **Yiou Zhu (3 min)** Investigating the spatial variation in nutrient and contaminant levels of *Maurolicus muelleri* among Norwegian fjords, the North Sea and Bay of Biscay	17:30	**Report back and discussion of synthesis paper outline**		
17:40	**Closing the workshop and follow-up initiatives** Molly Ahern and Maarten Bavinck (Leaders)			17:50	**Conclusions**
17:55	**Workshop 3 Ends**				
		18:10	**Concluding Remarks and Next Steps**	18:10	**Workshop 6 Ends**
		18:20	**Workshop 4 Ends**		

Opening Cermony, Plenary, S2, S3, S7 Sessions Schedules, November 8

Opening Ceremony and Plenary [Auditorio 2]	
9:00	**Opening Ceremony** **Ryan Rykaczewski** Welcome remarks on behalf of the symposium convenors **Teresa Coelho** (Secretary of State for Fisheries, Ministry of Agriculture and Food, Portugal) Welcome remarks on behalf of the host country **Manuel Barange** (Director, Fisheries and Aquaculture Division, FAO) Welcome remarks on behalf of FAO (recorded) **Enrique Curchitser** (Chair, PICES) Welcome remarks on behalf of PICES **Julie Kellner** (Professional Officer, ICES) Welcome remarks on behalf of ICES
9:20	**Susana Garrido (General Plenary)** Small pelagic fish in Portuguese waters: It all comes down to sardine (and some anchovy, recently)
9:50	**Shin-ichi Ito (General Plenary)** A way forward to elucidate small pelagic fish response to climate change
10:20	**Martin A. Pastoors (General Plenary)** Sustainable collaborative approaches between the fishing industry and fisheries science
10:50	***Coffee/Tea Break***
11:10	**Akinori Takasuka (Session 2 Plenary)** Density-dependent egg production in small pelagic fish: A key to life cycle closure
11:40	**Mary Hunsicker (Session 3 Plenary)** Detecting and forecasting the potential for community-level shifts in marine ecosystems
12:10	~~**Elena Ojea (Session 7 Plenary)**~~ **CANCELLED** ~~Adaptation pathways for small-scale fishers facing climate change impacts~~
12:40	***Lunch***

S2 (Day 1) [Auditorio 3] *Life Cycle Closure: Advances in Process Understanding*		**S3 (Day 1)** [Auditorio 2] *Understanding Population- and Ecosystem-level Shifts: From Seasonal Timing to Tipping Points*		**S7** [Sala 1] *Advancing Social-ecological Analyses and Sustainable Policies for Dependent Human Communities*	
14:00	**Introduction by Convenors**	14:00	**Introduction by Convenors**	14:00	**Introduction by Convenors**
14:05	**Laure Pecquerie (Invited)** What do we learn with Dynamic Energy Budget (DEB) models for small pelagic fish?	14:05	**Joël M. Durant (Invited)** Match-mismatch, trophic interactions and climate change	14:10	**Jeppe Kolding** Small low-cost pelagic fish in relation to food security and nutrition
14:30	**Lola De Cubber** A generalized Dynamic Energy Budget model including 3D shape changes for modeling small pelagic fish growth	14:30	**Sofia Ferreira** Impacts of the match-mismatch hypothesis across three trophic levels – A case study in the North Sea	14:30	**Farisal U. Bagsit** The Visayan Sea Seasonal Fishery Closure: Effectiveness from the standpoints of fishery-dependent communities and fishery management

Sessions S2, S3, S7 Schedules, November 8 (cont.)

S2 (Day 1) Cont. [Auditorio 3]		**S3 (Day 1) Cont.** [Auditorio 2]		**S7 Cont.** [Sala 1]	
14:50	**Clara Menu** Decreasing trend in size for small pelagic fish across European waters: Bioenergetic modeling to explore the underlying individual to population scale processes	14:50	**Michelle Staudinger** Phenological variation in forage fishes and trophic consequences for top predators in the Gulf of Maine	14:50	**Rodgers Makwinja** Lake Malombe fishing communities' livelihood, vulnerability, and adaptation strategies
15:10	**Anna Akimova** A new insight into feeding conditions of North Sea herring larvae: Combining field observations and physiological modelling	15:10	**Annegret Finke** ***(cancelled)*** Winter effects on the feeding phenology of early herring (*Clupea harengus*) larvae in a major Western Baltic Sea nursery area	15:10	**Chih-Heng Cai** Assessment of risks and resilient of the coastal fisheries Industry under climate change - A case study of set-net fishery in Taiwan and Japan
15:30	**Susan Kenyon** Fat dynamics of Atlantic herring (*Clupea harengus*) at the onset of sexual maturation: The dual-fuel powering used by maatjes herring	15:30	**Elisabeth Henderson** ***(cancelled)*** Seasonal variability in Northern anchovy (*Engraulis mordax*) in Monterey Bay, California	15:30	**Part 1 Wrap Up**
15:50	***Coffee/Tea Break***	15:50	***Coffee/Tea Break***	15:50	***Coffee/Tea Break***
16:10	**Eudoxia Schismenou** Anchovy and sardine somatic condition and energy content in the North Aegean Sea (eastern Mediterranean)	16:10	**Rebecca Asch** How accurately and precisely can fisheries-independent surveys assess phenological change?	16:10	**Dimitri Gutierrez (Invited)** Seventy years of management of the Peruvian anchoveta fishery under high environmental variability: Lessons and challenges for future climate change scenarios
16:30	**Mikio Watai** Interannual variations in egg diameter of two mackerel species in the western North Pacific	16:30	**Anna Neuheimer** Using models of thermal time to observe the unobserved and identify meaningful change	16:35	**Jennifer Beckensteiner** Resilience for whom and according to what criteria? An examination of adaptations to changes in the Bay of Biscay anchovy fishery
16:50	**Rikuto Utsugi** Egg size variability in Japanese sardine in the Kuroshio Current system at a multidecadal scale	16:50	**Christopher Rooper** Evaluating factors affecting the distribution and timing of Pacific Herring spawn in British Columbia	16:55	**Martin Huret** Fish quantity, and quality, impact french small pelagic fisheries through bottom-up and industry controls
17:10	**Tomohiro Hirasawa** Egg size variability in Japanese anchovy under the species alternations between anchovy and sardine in the Kuroshio Current system	17:10	**Mathieu Doray** Comparison of the space-time dynamics of clupeiformes fish size-structured habitats in Atlantic (Bay of Biscay) and Mediterranean (Gulf of Lion) French shelf seas	17:15	**Maria Gasalla** The sardine fisheries under economic scrutiny
17:30	**Cristina Nunes** Condition factor and length-weight relationship for small pelagic fishes in the Atlantic Iberian coast	17:30	**Wrap up**	17:35	**Part 2 Wrap Up**
17:50	**Wrap up**				
18:00	**S2 (Day 1) End**	18:00	**S3 (Day 1) End**	18:00	**S7 End**

Plenary, S2, S3, S6 Sessions Schedules, November 9

Plenary [Auditorio 2]	
9:00	**Marta Coll (General Plenary)** Winners, losers and shifts of the pelagic ecosystem in the Mediterranean Sea
9:30	**Arnaud Bertrand (General Plenary)** The metamorphosis of small pelagic fish
10:00	**Modesta Medard (General Plenary)** A key driver of change in small pelagic fishery (*dagaa*) in Lake Victoria, Tanzania
10:30	**Carryn de Moor (Session 6 Plenary)** Including quantitative ecosystem objectives in Management Strategy Evaluation of South Africa's small pelagics
11:00	***Coffee/Tea Break***

S2 (Day 2) [Auditorio 3] *Life Cycle Closure: Advances in Process Understanding*		**S3 (Day 2)** [Auditorio 2] *Understanding Population- and Ecosystem-level Shifts: From Seasonal Timing to Tipping Points*		**S6 (Day 1)** [Sala 1] *Reconciling Ecological Roles and Harvest Goals: Development and Testing Management Strategies to Safeguard Marine Ecosystem Services*	
11:20	**Shota Tanaka** Growth autocorrelation in small pelagic fish larvae in the Kuroshio Current system: Do early growth rates influence later growth rates?	11:20	**Matthew Baker** Arctic sandlance range expansion in the Arctic – Analyses of spatial distribution related to oceanographic and physical habitat	11:20	**Introduction by Convenors**
				11:25	**Amy Schueller (Invited)** A novel multispecies framework for setting ecological reference points for Atlantic menhaden management
11:40	**Florian Berg** Growth trade-offs for spring- and autumn-hatched larvae; Results from a long-term experiment	11:40	**Muhamad Naimullah** The influence of El Niño–Southern Oscillation (ENSO) events on the catches trends and habitat shifting of three swimming crabs in the Taiwan Strait		
				11:50	**Henrik Sparholt (recorded)** Baltic sprat management strategy evaluation using a Surplus Production Model as biological model
12:00	**Andreia Silva** Hatch earlier or late? Survival of sardine (*Sardina pilchardus*) juveniles in response to environmental and parental effects	12:00	**Ruben Rodriguez-Sanchez** Spatial dynamics of the Pacific sardine (*Sardinops sagax*) in the California Current system: Connecting seasonal, interannual, and long-term movements		
				12:10	**Robert Wildermuth** Evaluating robustness of harvest control rules to variability in Pacific sardine recruitment
12:20	**Bocar Sabaly Baldé** Population structure, age and growth of sardine (*Sardina pilchardus*, Walbaum, 1792) in an upwelling environment	12:20	**Jeroen van der Kooij** Northward range expansion of Bay of Biscay anchovy due to increased temperature envelope and population increase		
12:40	***Lunch***	12:40	***Lunch***	12:30	***Lunch***
14:00	**Afonso Ferreira** Using environmental and biological satellite data to understand recruitment in two small pelagic fish species in Atlanto-Iberian waters (European sardine and European anchovy)	14:00	**Pierre Petitgas** Density-dependence in the spatial distribution of Bay of Biscay anchovy	14:00	**Michael Wilberg** Evaluation of harvest control rules for joint management of Atlantic menhaden and striped bass

Sessions S2, S3, S6 Schedules, November 9 (cont.)

S2 (Day 2) Cont. [Auditorio 3]		**S3 (Day 2) Cont.** [Auditorio 2]		**S6 (Day 1) Cont.** [Sala 1]	
14:20	**Sónia Antunes** Environmental effects on sardine (*Sardina pilchardus*, Walbaum 1792) larvae somatic and otolith growth off Iberian Peninsula	14:20	**Juan Pablo Zwolinski** The school trap hypothesis predicts the distribution patterns and environmental preferences of Pacific Sardine in the California Current following the 2010s collapse	14:20	**Richard Nash** Use of Management Strategy Evaluation to derive a sustainable and precautionary harvest rate for a data-limited stock of sprat in the English Channel
14:40	**Marta Moyano** Caught in the middle: Bottom-up and top-down processes impacting recruitment in Western-Baltic herring	14:40	**Jennifer Boldt** Incorporating ecosystem information into science advice – A case study for Haida Gwaii Pacific Herring	14:40	**Laura Wise** Evaluation of harvest control rules under different productivity regimes - The Iberian sardine case study
15:00	**Ignacio Catalán** Worldwide appraisal of knowledge gaps in the space usage of SPF highlights across stock uncertainties and research priorities	15:00	**Lina Livdane** A recent decline in zooplankton density in the inshore Western Baltic Sea	15:00	**Sonia Sánchez-Maroño** Managing data-limited stocks with harvest rate-based rules based on an abundance index
15:20	**Luz María García-García** Uncertainties derived from the hydrodynamic forcing of a Lagrangian IBM for the Iberian Atlantic sardine	15:20	**Haruka Nishikawa** Kuroshio induced sardine stock fluctuation: From the Kuroshio dynamics to the food availability	15:20	**Toshihide Kitakado** Development of management procedures for the Pacific saury, *Cololabis saira*
15:40	***Coffee/Tea Break***	15:40	***Coffee/Tea Break***	15:40	***Coffee/Tea Break***
16:00	**Margot Maathuis** Fourteen months of continuous acoustic measurements: The behaviour and biomass of small pelagic fish in one of the passageways to the Wadden Sea revealed	16:00	**Sebastián Vásquez** Do global ocean events modulate early survival through the larval retention-advection of anchoveta (*Engraulis ringens*) in the southern Humboldt system?	16:00	**Nis Sand Jacobsen** The impact of natural mortality on reference points and management strategies of forage fish populations
16:20	**Kohma Arai** Machine learning and otolith isoscapes to evaluate decadal trends in contingent mixing of Atlantic mackerel	16:20	**Bocar Sabaly Baldé** Bonga shad (*Ethmalosa fimbriata*) stock-recruitment relationship in an upwelling environment	16:20	**Alexnadra Silva** Spatial population dynamics of sardine in the Northeast Atlantic and the western Mediterranean Sea: Defining areas, estimating movement rates and exploring spatial stock assessment models
16:40	**Dorothee Moll** First evidence of precise homing behavior to natal spawning habitats in Atlantic herring (*Clupea harengus*) within the concept of a metapopulation	16:40	**Brenda Temperoni** Environmental factors affecting anchovy *Engraulis anchoita* reproductive potential in the northern Argentinean Continental Shelf	16:40	**Dorota Szalaj** Informing the ecosystem-based fisheries management of the Iberian sardine stock in the Portuguese continental shelf through a spatial-temporal food-web model

Sessions S2, S3, S6 Schedules, November 9 (cont.)

S2 (Day 2) Cont. [Auditorio 3]		**S3 (Day 2) Cont.** [Auditorio 2]		**S6 (Day 1) Cont.** [Sala 1]	
17:00	**Alexanra Bagarinao-Regalado** Spatial dynamics of *Sardinella lemuru* in central Philippine waters inferred from georeferenced sardine catches	17:00	**Antonio Palermino** Habitat suitability modelling and impact of environmental factors on the distribution of *Sprattus sprattus* in the Adriatic Sea	17:00	**Naseera Moosa** Investigating the influence of 'minor' krill-predators (the leopard seal, Adelie penguin, marbled rockcod and mackerel icefish) on the krill-predator dynamics of the Antarctic ecosystem in the IWC (International Whaling Commission) Management Area II
17:20	**Ana Teles-Machado** Variable anchovy dispersion patterns in the Iberian Current System	17:20	**Discussion**	17:20	**Pierre-Yves Hernvann** Fishing fleets *vs* Predator: Can we reconcile the ecological roles of small pelagic fish and their exploitation in a climate change context?
17:40	**Discussion**			17:40	**Laurence Kell** Sustainable exploitation of Celtic Sea sprat avoiding ecosystem impacts
18:00	**S2 End**	18:00	**S3 End**	18:00	**S6 (Day 1) End**

Plenary, S1, S5, S6 Sessions Schedules, November 10

Plenary [Auditorio 2]	
9:00	**Carl D. van der Lingen (Session 1 Plenary)** Trophodynamic processes and small pelagic fishes
9:30	**Renato Salvatteci (Session 4 Plenary)** A paleoceanographic perspective on the future of fish productivity in the Humboldt Current system
10:00	**Noelle Bowlin (Session 5 Plenary)** CalCOFI's past, present, and future role in the ecosystem approach to fishery research
10:30	***Coffee/Tea Break***

S1 (Day 1) [Auditorio 2] *Trophodynamic Processes*		**S5 (Day1)** [Auditorio 3] *Progress in Pelagic Surveys: From Biomass Estimates to Monitoring Ecosystems*		**S6 (Day 2)** [Sala 1] *Reconciling Ecological Roles and Harvest Goals: Development and Testing Management Strategies to Safeguard Marine Ecosystem Services*	
10:50	**Introduction by Convenors**	10:50	**Introduction by Convenors**	10:50	**<u>João Vaz Patto</u>** A bioeconomic model for the Portuguese purse seine fleet: Towards an ecosystem-based management
10:55	**<u>Marta Albo-Puigserver</u> (Invited)** Trophic ecology of small pelagic fish in the Mediterranean Sea: Overall knowledge, recent advances and future challenges	10:55	**Timothy Ward (Invited)** Insights from Down Under: DEPMs on four species over 25 years and 350,000 km^2	11:10	**<u>Katie Brigden</u>** Industry-science collaboration to enhance traditional fisheries data collection
11:20	**Leonardo Castro** SPF from different origin sharing an area limit of their latitudinal distribution: Dynamic factors facilitating habitat partitioning	11:20	**<u>Sven Gastauer</u>** Evaluation of the uncertainty of the Herring Acoustic-Trawl Survey – A geostatistical approach	11:30	**Joseph Nyingi Kamau** The North Kenya Banks pelagic fishery in the context of climate change
11:40	**Catriona Clemmesen** Effects of climate change on the abundance of herring and sprat larvae in Kiel Fjord (Baltic Sea)	11:40	**Serdar Sakinan** Spatially explicit synthetic simulations towards an improved acoustic assessment of the North Sea herring stock	11:50	**Cecilie Hansen** Exploring responses in Norwegian spawning herring to multiple stressors using an end-to-end ecosystem model (NoBa Atlantis)
12:00	**Hugo Mendes** Spatio-temporal patterns of feeding intensity and relationship with productivity cycles in Portuguese waters	12:00	**Espen Johnsen** An end-to-end use of advanced acoustic surveys in spatial management of the lesser sandeel (*Ammodytes marinus*)	12:10	**Isaac Kaplan** Projections of climate change impacts on California Current pelagic species, and on the performance of harvest rules and stock assessments
12:20	**<u>Miram R. Gleiber</u>** The pelagic species trait database, an open data resource to promote trait-based fisheries research	12:20	**<u>Diana Feijó</u>** Purse-seine fishery in Portugal: No sardine, no future?	12:30	**Dimitri Gutierrez** Observation, prediction and early warning system for the resilience of small pelagic fisheries in the Humboldt Current Large Marine Ecosystem
12:40	***Lunch***	12:40	***Lunch***		

Sessions S1, S5, S6, S4 Schedules, November 10 (cont.)

				12:50	**Martin A. Pastoors** Key lessons for fishing industry self-sampling programs
				13:10	**Discussion and wrap up**
				13:30	**S6 End**
S1 (Day 1) Cont. [Auditorio 2] *Trophodynamic Processes*		**S5 (Day 1) Cont.** [Auditorio 3] *Progress in Pelagic Surveys: From Biomass Estimates to Monitoring Ecosystems*		**S4 (Day 1)** [Sala 1] *Responses to Climate Variability and Change at Decadal to Centennial Time Scales*	
14:00	**Richard Brodeur** A global stable isotope-based trophic level comparison of small pelagic fish and other nekton across ecosystems with varying levels of productivity	14:00	**<u>David McGowan</u>** Improved monitoring of forage species in the Gulf of Alaska in the absence of directed surveys	14:00	**Introduction by Convenors**
14:20	**<u>Elena Lloret-Lloret</u>** Small pelagic fish fitness relates to local environmental conditions and trophic variables	14:20	**Abdoulaye Sarre** **(*by Hector Pena*)** Investigation of bias in echosounder acoustic surveys using omnidirectional sonar from South to Northwest Africa	14:05	**Michinobu Kuwae (Invited)** Long-term dynamics in marine ecosystems in the northwest Pacific — A lesson from sedimentary records
14:40	**Francis Juanes** Allometry of predator-prey relationships in SPF	14:40	**Raymond M Mroch III** NOAA Fisheries' approach to monitoring the Gulf and Atlantic menhaden fisheries, 60 years of progress	14:30	**<u>Lane Atmore</u>** Using ancient DNA to uncover the history of Atlantic herring exploitation and its impact on herring evolution and demography
15:00	**Hounaida Farah Idrissi** Food ecology of the sympatric species of the snipefish *Macroramphosus* spp. in the Upwelling region between latitudes 26°N (Cap Bojdour) and 20°50'N (Cap Blanc)	15:00	**Claus Sparrevohn** Large scale tagging and recapture of small pelagics	14:50	**Motomitsu Takahashi** Interdecadal variabilities in growth and temperature histories of young jack mackerel off western Kyushu: 1960-70s vs. 2000-10s
15:20	**<u>Joan Giménez</u>** Seasonal and spatial variation of the trophic position of European sardine in the NW Mediterranean Sea using compound-specific stable isotope analyses	15:20	**Andres Uriarte** DEPM BIOMAN survey series in the Bay of Biscay: Lessons learned after 35 years of tracking the anchovy population in its ecosystem	15:10	**<u>Zhen Lin</u>** Historical variability of fish body weight around Japan
15:40	***Coffee/Tea Break***	15:40	***Coffee/Tea Break***	15:30	**<u>Tatsuya Sakamoto</u>** Contrasting life-history responses to climate variability in eastern and western North Pacific sardine populations
				15:50	***Coffee/Tea Break***

Sessions S1, S5, S4 Schedules, November 10 (cont.)

S1 (Day 1) Cont. [Auditorio 2]		**S5 (Day 1) Cont.** [Auditorio 3]		**S4 (Day 1) Cont.** [Sala 1]	
16:00	**Marta Moyano** The big unknowns on the feeding dynamics during the early life stages of small pelagic fishes	16:00	**Manuel Ruiz-Villarreal** The W and N Iberian pelagic ecosystem in spring assessed with Pelacus surveys: Environmental variability and spatio-temporal changes in food web structure and ecosystem functioning		***Coffee/Tea Break* Cont.**
16:20	**Claudia Ofelio** Understanding the vulnerability of Peruvian anchovy larvae to environmental variables	16:20	**Daniela Silva** Spatio-temporal variability of the distribution and abundance of small pelagic fish off the Portuguese continental coast and relationship with environmental drivers	16:10	**Carola Hernández-Santoro** Changes in the reproductive tactics of the anchoveta (*Engraulis ringens*) as compensation or adaptation to environmental variability?
16:40	**Bruno Louro** Fisheries metagenomics case study: Sardine and their prey	16:40	**Mathieu Doray** Anchovy and sardine springtime habitats in the European Atlantic area	16:30	**Jorge López-Parages** El Niño as a predictor of round sardinella distribution along the northwest African coast
17:00	**Ana Veríssimo** Egg predation by sardine and chub mackerel off the Iberia: No fish is safe	17:00	**Miram R. Gleiber** Integrating forage surveys, diet studies, and trait information to explore prey preferences of a pelagic predator - albacore tuna	16:50	**Goncalo Silva** "Move, adapt or go extinct": Responses of small pelagic fish to global changes in the northeastern Atlantic
17:20	**Hiroaki Saito** Factors controlling reproduction of copepods in the Kuroshio region	17:20	**Sarah Gaichas** Assessing small pelagic fish trends in space and time using piscivore diet data	17:10	**Filomena Vaz Velho (recorded?)** Marine heatwaves and availability of sardinella to coastal fisheries: The case of Angola, 1994-2015
17:40	**Kjetil Gjeitsund Thorvaldsen** Hiding in plain sight: Predator avoidance behaviour of mesopelagic fish during foraging	17:40	**Sk Istiaque Ahmed** Detection of fish species by MiFish analysis from the eDNA samples collected from intake-water (3m), surface-water (0m) & Niskin bottles (5m or 10m) and comparison among them to understand their suitability	17:30	**Discussion**
18:00	**Wesley W. Strasburger** A review of the thiamine status of Alaskan Chinook stocks and a note from the California Current Ecosystem	18:00	**Discussion**	18:00	**S4 (Day1) End**
18:20	**S1 (Day1) End**	18:10	**S5 (Day1) End**		

Sessions S1, S5, S4 Schedules, November 11

S1 (Day 2) [Auditorio 2] *Trophodynamic Processes*		**S5 (Day 2)** [Auditorio 3] *Progress in Pelagic Surveys: From Biomass Estimates to Monitoring Ecosystems*		**S4 (Day 2)** [Sala 1] *Responses to Climate Variability and Change at Decadal to Centennial Time Scales*	
9:00	**Jim Ruzicka** The role of small pelagic fish in diverse ecosystems: Information gleaned from food-web models	9:00	**Victor Odongo** Inter- and intra-annual variations in the fish community structure related to abiotic drivers in the Sylt-Rømø Bight, southeastern North Sea, Germany	9:00	**Joel K. Llopiz CANCELLED** Ecology and long-term dynamics of small pelagic fishes on the Northeast US continental shelf
9:20	**Brian Wells** The role of small pelagic fishes on negative Pacific hake and salmon interactions along the Northern California Current	9:20	**Sidi Ahmed Hemed** Biomass and geographical distribution of seven small pelagic fish species in relation to temperature conditions in Mauritanian waters	9:20	**Jimmy T. Masagca** Small pelagic fishes and fisheries in coastal waters of Catanduanes island, Philippines within climate variability
9:40	**Natasha A. Hardy** Modelling diet shifts in a pelagic predator – albacore tuna – in relation to forage community composition and prey trait information across a 2005–2019 time series	9:40	**Mariano Gutierrez** Relationship of oceanic vorticity to catches of jack mackerel (*Trachurus murphyi*) in the Peruvian Sea between 2011 and 2021	9:40	**Po-Yuan Hsiao** Impacts of climate change-induced environmental fluctuations on the structure of marine ecosystem around the Taiwan Bank
10:00	**Joana Raimundo** Anthropogenic pollutants in small pelagic fishes	10:00	**Asuncion B. de Guzman** A novel satellite-based approach to mapping spatio-temporal spawning patterns of sardines in northern Mindanao, Philippines	10:00	**Peter Kuriyama** Evidence of density-dependent, time-varying processes in Pacific sardine stock assessments
10:20	**Martin Wiech** Trophic ecology and its influence on metal transfer in the mesopelagic food-web from Norwegian Fjords and the North Sea: A multi-tracer approach using stable isotope and fatty acid analyses	10:20	**Cian Kelly** Classifying pelagic fishing vessel activity based on data from electronic catch logs and positioning systems using machine learning methods	10:20	**Stefan Koenigstein** Mechanistic population projections for sardine and anchovy in the California Current under ocean warming and changing food availability
10:40	***Coffee/Tea Break***	10:40	***Coffee/Tea Break***	10:40	***Coffee/Tea Break***
11:00	**Yiou Zhu** Trophodynamics of mesopelagic communities elucidates their roles in food security and sustainable nutrition provision	11:00	**Benoit Berges** Processing and interpretation of opportunistic acoustic data collected by Dutch fishing vessels	11:00	**Timothee Brochier** Population traits in small pelagic fish model: Emergence from interactions between a turbulent environment and individual behaviors in Upwelling Systems
11:20	**Susan G. Montero Salgado** Acoustic detection of macrozooplankton, and its relationship with the concentration of omegas 3, obtained by the vessels of Pesquera Diamante	11:20	**Paco Rodriguez-Tress** Using Vessel Monitoring System, electronic log-book and landing data to link fishing effort and vessel trajectory to spawning stock biomass and catches	11:20	**Ziqin Wang** Development of a bioenergetics and population dynamics coupled model: An example of Pacific chub mackerel

S1, S5, S4, Plenary Sessions, Closing Ceremony Schedules, November 11 (cont.)

S1 (Day 2) Cont. [Auditorio 2]		**S5 (Day 2) Cont.** [Auditorio 3]		**S4 (Day 2) Cont.** [Sala 1]	
11:40	**Mathilde Bertrand** Changes in the diet of Bay of Biscay sardines according to sampling location and age, through fatty acid composition	11:40	**Stefanie Haase** Cooperative research: The integration of fishing industry-collected data to improve temporal coverage of hydroacoustic data collection	11:40	**Jazel Ouled-Cheikh** Stronger together: Fisheries enhance pressure on Mediterranean regions and pelagic species already impacted by climate change
12:00	**Brenda Temperoni** Trachurus lathami: A pelagic fish species of ecological and technological relevance currently sub exploited in the South West Atlantic (34º- 45ºS)	12:00	**Steven Mackinson** Ready for industry-led pelagic acoustic surveys?	12:00	**Alana M. Krug-MacLeod** Effect of climate state on variation in nutritional value for small pelagic species
12:20	**Marta Caballero-Huertas** From West to East: Heterogeneity in the life history traits of the European sardine throughout the Mediterranean	12:20	**Ghoufrane Derhy** Assessing external environmental drivers for the Moroccan chub mackerel (*Scomber colias*) population dynamics	12:20	**Ndague Diogoul** On the robustness of an eastern boundary upwelling ecosystem exposed to multiple stressors
12:40	**Discussion and wrap up**	12:40	**Discussion and wrap up**	12:40	**Discussion and wrap up**
13:00	**S1 End, *Lunch***	13:00	**S5 End, *Lunch***	13:00	**S4 End, *Lunch***

Plenary Session and Closing Ceremony [Auditorio 2]	
14:30	**Juergen Alheit and Salvador E. Lluch-Cota (General Plenary)** Historical perspectives of international collaboration on SFP research
14:50	**Desiree Tommasi (General Plenary)** Future outlook for the science and management of small pelagic fish
15:10	**Session Summaries and Key Messages**
16:10	**Panel Discussion**
16:40	**Award Presentations**
16:55	**Closing Remarks**
17:00	**Symposium Ends**

ECS underlined

Poster Session, November 9
(Sala 2 and adjacent Hall)

GP-P1 **João Neves**
Temporal variations in otolith shape population structure on a small pelagic fish, the European sardine *Sardina pilchardus* (Walbaum, 1792), in a decadal period

GP-P2 **Alba Jurado-Ruzafa**
Influence of environmental variability on population traits of small pelagic fish in the Canary Islands (NW Africa, Spain)

GP-P3 **Alba Jurado-Ruzafa**
Using otolith phenotipic variability to infer potential population differences of *Scomber colias* in the Northeast Atlantic and Mediterranean Sea

GP-P4 **Alba Jurado-Ruzafa**
Prevalence of nematodes in *Sardinella aurita*, *Scomber colias* and *Trachurus picturatus* caught in the Canary Islands (Spain, NW Africa)

GP-P5 **Naoya Iwamoto**
Evaluation and prediction of small pelagic fish dynamics by an interspecific relation model under regime shifts

GP-P6 **Tse-Yu Teng**
Climate risks and opportunities of the marine fishery industry: A case study in Taiwan

GP-P7 **Andrea Franke**
How do Atlantic herring early life stages cope with ocean warming and bacterial infection?

GP-P8 **Criscely Luján**
Uncertainty analysis reveals key species and indicators in the Peru Current Ecosystem

GP-P9 **Michael Sswat**
Growth performance of larval anchoveta *Engraulis ringens* in a natural plankton community: First insights from a mesocosm study off Peru on the effect of different light regimes and upwelling intensities

GP-P10 **Ibrahim Al-Anboori**
Stock status of small pelagic fishery in Sultanate of Oman

GP-P11 **Lucilla Giulietti**
Occurrence of parasite-induced 'soft flesh' in some commercially important pelagic fish species from off Morocco: Product quality implications

GP-P12 **Joana M. Romero** CANCELLED
How do different seabird species reflect fluctuations of the Atlantic Herring population in the Bay of Fundy?

S1-P1 **Jazel Ouled-Cheikh**
Trophic importance of small pelagic fish to marine predators of the Mediterranean Sea

S1-P2 **Marta Caballero-Huertas**
Variability in the ascaridoid parasites load in the European sardine along the host distribution and its reproductive cycle

S1-P3 **Claudia Soares**
Effects of prey concentration on ingestion rates of European anchovy *Engraulis encrasicolus* larvae in the laboratory

S1-P4 **Mary E. Hunsicker**
Diet shifts in small pelagic fishes during a marine heatwave: Insights from isotope mixing models

S1-P5 **Pedro Fonseca**
Gastric evacuation rate of European sardine and Atlantic chub mackerel: The effects of different diets and the application of the results to predation estimates

Poster Session, November 9
(Sala 2 and adjacent Hall)

S1-P6 **Paul Kotterba**
A wolf in sheep's clothing – Planktivorous Baltic herring preying on estuarine demersal fishes

S1-P7 **Pedro Pousão-Ferreira** (submitted by Ana C. Matias)
Understanding protein requirements in *Sardina pilchardus*

S1-P8 **Abdelghafour El kadmiri**
Preliminary contribution on the aspect ratio (A) of small and large pelagic species in the South Atlantic area of Morocco

S1-P9 **Bram Parmentier**
The spatiotemporal abundance, distribution, and energy content of sandeel (*Ammodytidae spp*.) in the southern North Sea. Potential top-down impacts of seal populations on this forage fish resource.

S1-P10 **Ana Veríssimo**
Diet of SPF larvae off Atlantic Iberian waters: New insights using molecular techniques

S1-P11 **Mary Beth Decker**
Dietary and spatial overlap among jellyfish and small pelagic fish in the eastern Bering Sea

S1-P12 **Johannes Sahlsten**
Prevalence and molecular identification of Corynosoma in Baltic herring (*Clupea harengus membras*) and great cormorant (*Phalacrocorax carbo*)

S1-P13 **Jose María Quintanilla Hervás** (or Raúl Laiz Carrión)
Isotopic niche plasticity of sardine larvae in the northern Alboran Sea (W Mediterranean)

S1-P14 **Pedro Pousão-Ferreira**
Atlantic sardine *Sardina pilchardus* is able to elongate and desaturate LC-PUFA?

S1-P15 **Florbela Soares CANCELLED**
Parasites occurrence on farmed European sardine (*Sardina pilchardus*)

S1-P16 **Richard Brodeur**
Parasites of small pelagic fishes reflect their place in marine ecosystems

S1-P17 **Ana Moreno**
Helminth parasites of *European pilchardus*, *Sardina pilchardus* (Walbaum, 1792) from the Portuguese coast

S2-P1 **João Neves**
Comparing otolith shape descriptors for population structure inferences in a small pelagic fish, the European sardine *Sardina pilchardus* (Walbaum, 1792)

S2-P2 **Tora Olsen**
Predator abundance shifts spawning ground use in the Barents Sea capelin (*Mallotus villosus*)

S2-P3 **Florian Berg**
Understanding the underlying mechanisms affecting growth of small pelagic fish:
An experimental meta-analytical approach

S2-P4 **Claudia Soares**
Assessing sardine larvae condition: Results from the lab to the sea

S2-P5 **Pierre Petitgas**
Growth related selective mortality in adult European anchovy and sardine

S2-P6 **Jairo Gutiérrez**
Spatio-temporal distribution and abundance indices for common sardine (*Strangomera bentincki*) and anchovy (*Engraulis ringens*) in the southeastern Pacific coast between 1999 and 2021

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S2-P7 **Martin Huret**
A cross-system comparison of internal and external forcing regulating growth of small pelagic fish throughout ontogeny

S2-P8 **Isabel Meneses**
Demographic study of early life history stages of *Sardina pilchardus* (Walbaum, 1792) larvae off the northwestern Portuguese coast

S2-P9 **Isabel Meneses**
Otolith daily growth of sardine (*Sardina pilchardus*, Walbaum 1792) larvae off western Iberia: Effect of environmental variables

S2-P10 **Salah Eddine Sbiba**
Insight into the stock structure of *Scomber colias* along the Northwest coast of Africa

S2-P11 **Rebecca Howard**
The influence of ontogeny and size on the distribution of juvenile forage fishes

S2-P12 **Jessica Qualley**
Otolith microchemistry methods to identify migration life history variation in Pacific Herring (*Clupea pallasii*) in the Strait of Georgia, British Columbia, Canada

S2-P13 **Gregor Börner**
Response of Atlantic herring larvae to ocean alkalinity enhancement

S2-P14 **Andrea Massaro**
Verification, corroboration and validation of the anchovy, *Engraulis engrasicolus* (Linnaeus, 1758) age analysis in the Central-Southern Tyrrhenian Sea (West Mediterranean)

S2-P15 **Daniel Brüggemann**
Performance of herring larvae under ocean alkalinity enhancement, an ocean-based carbon dioxide removal technique, in a mesocosm approach

S2-P16 **Susana Garrido**
Thermal tolerance sharply increases during larval development for European sardine (*Sardina pilchardus*)

S2-P17 **Andreia V. Silva**
Age validation of Atlantic chub mackerel (*Scomber colias*) in the Northeast Atlantic area

S3-P1 **Ana Moura**
A review on the dynamics of small pelagic fish species in the Western Iberia Upwelling ecosystem

S3-P2 **Elena Fernández Corredor**
The influence of environmental factors on different life stages of anchovy (*Engraulis encrasicolus*) and sardine (*Sardina pilchardus*) in the Mediterranean Sea

S3-P3 **Jennifer Boldt**
Canada's forage fish: An important but poorly understood component of marine ecosystems

S3-P4 **Marta Moyano**
Revisiting the stability of the environmental constraints shaping the spatial distribution of Peruvian and European anchovy

S3-P5 **Marcos A. Arteaga**
Interannual wind variability as a key driver of anchoveta (*Engraulis ringens*) recruitment in southern Humboldt system

S3-P6 **John Gabriel Ramírez Téllez**
Linking events affecting timeseries of landings of small-pelagic fisheries in the Mediterranean Sea: Does it affect current stock assessment?

S4-P1 **Alba Jurado-Ruzafa**
Deepening our pelagic vision of the small pelagic fish in the Canary Islands (NW Africa, Spain)

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S4-P2 **Jéssica F. R. Coelho**
Climate modelling indicates poleward shift and range contraction of the scaled sardines *Harengula* sp. in the Atlantic Southwest

S4-P3 **Rosario Dominguez-Petit**
The Atlantic chub mackerel (*Scomber colias*) in the Iberian Atlantic waters: Growth patterns and cohorts strength

S4-P4 **Ryan R. Rykaczewski**
Scales of variability: Shifts in spatial distribution with population size can complicate interpretation of the sedimentary scale record for small pelagic fish of the California Current

S4-P5 **Po-Yuan Hsiao (poster & talk)**
Impacts of climate change-induced environmental fluctuations on the structure of marine ecosystem around the Taiwan Bank

S4-P6 **Ndague Diogoul (poster & talk)**
On the robustness of an eastern boundary upwelling ecosystem exposed to multiple stressors

S5-P1 **Magdy Ahmed Abdelwahed (No Show)**
Summary of the study on tuna fishing in the Mediterranean Sea in Egypt

S5-P2 **Christopher N. Rooper**
Surveying and monitoring nearshore forage fish in the Salish Sea using acoustic-optic technologies

S5-P3 **Vivian Fischbach**
A staging system for *Clupea harengus* based on its skeletal development

S5-P4 **Amanda Rezek**
Comparison of ages determined by using an Eberbach projector and a microscope to read scales from Atlantic menhaden (*Brevoortia tyrannus*) and Gulf menhaden (*B. patronus*)

S5-P5 **Claudia Musumeci**
Stock status of European anchovy and sardine in Ligurian and Northern Tyrrhenian Sea: Recent insights from fifty years of data

S5-P6 **Francisco Plaza**
Deep learning and surplus production models for multivariate autoregressive modelling and simulation of the jack mackerel fishery associated with environmental conditions

S5-P7 **Domenico Ciorciaro**
Ecosystem Based-Management for small pelagic fisheries – From local to regional scales

S5-P8 **Dolores Garabana**
Challenges in DEPM implementation for NE Atlantic mackerel

S5-P9 **Paula Alvarez Jorna**
The implementation of the DEPM in Western horse mackerel during the Triennial mackerel and horse mackerel surveys (MEGS): Pros and cons

S5-P10 **Ana Ventero**
Long time series (2009-2020) analysis of *Trachurus trachurus* and *Trachurus picturatus* spatial distribution and life history traits in the Western Mediterranean

S5-P11 **Magdalena Iglesias**
Biological parameters and overlapping distribution of *Sardinella aurita* spawners and eggs in the Spanish Mediterranean Sea continental shelf

S5-P12 **Maria Manuel Angélico**
Adding value to regular fisheries surveys for pelagic ecosystem monitoring. Water quality assessment for MSFD requirements.

S5-P13 **Anas Yassir**
A review of the contribution of deep learning and machine learning to fishery acoustic

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S5-P14 **Dina Silva**
Validation of growth increment formation and first annual increment formation in European anchovy (*Engraulis encrasicolus*) in the Northwest Atlantic Area

S5-P15 **Maria Manuel Angélico**
Plankton-sized microplastics in Portuguese coastal waters. Taking advantage of regular monitoring surveys

S5-P16 **Kim P. Nuñez**
Monitoring catch and effort and linking fleet movement of sardine fishery in Fisheries Management Area (FMA) 7, Philippines

S5-P17 **Cristina Nunes**
DEPM surveys and spawning behaviour of horse mackerel (*Trachurus trachurus*) from the Atlantic Iberian-southern stock (ICES 9a)

S5-P18 **Tyler Ellis Sharpton**
Biomass and distribution of cnidarians and ctenophores in Icelandic waters during the summer in relation to environmental variables and lumpfish distributions

S5-P19 **Jeroen van der Kooij** and **Maria Manuel Angélico**
Pelagic ecosystem surveying in NE Atlantic Waters: WGACEGG internationally coordinated survey

S5-P20 **Raúl Laiz Carrión**
Ichthyoplankton evidences of European sardine connectivity between north and south of Alboran Sea, and adjacent waters

S5-P21 **Diana Feijó (poster & talk)**
Purse-seine fishery in Portugal: No sardine, no future?

S6-P1 **Sylvan Benaksas**
The spatiotemporal distribution of seabird prey fish in the North Sea

S6-P2 **Deirdre Hoare**
Fishing practice and the ecosystem approach - Case studies on Panama and Ecuador small pelagic fisheries and how fishery improvement projects can effect management strategy and sustainability

S6-P3 **Inês C. Dias**
Combining data on fish size and VMS to model the spatio-temporal distribution of sardine and chub mackerel juveniles

S6-P4 **Michelle Staudinger**
A keystone issue: Managing forage fishes in a changing climate

S6-P5 **Desiree Tommasi**
Impact of climate and ecosystem change on the California Current forage complex and the fishing communities and predators it sustains

S7-P1 **Jimmy T. Masagca**
An integrated risk-based assessment of Cabugao bay in Catanduanes, Philippines for small pelagic fishes to guide ecosystem-based management

S7-P2 **Mohammad Minhazul Islam**
COVID-19 pandemic disrupts the supply chain of small-scale tropical pelagic fisheries: Lessons from Bangladesh

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W1-P1 **Edmund Kajuni (No Show)**
A morphological and phylogenetic investigation of tilapiine fishes of the *genus oreochromis* in Southern Tanzania

W1-P2 **Joana I. Robalo**
Genclim – A project on the evolutionary and socio-economic consequences of shifting distribution ranges in commercially exploited marine fishes

W1-P3 **María-Eugenia López**
Lack of panmixia of Gulf of Bothnia vendace - Implications for fisheries management

W2-P1 **Jung Jin Kim (No Show)**
Understanding the distribution and transport processes for the early life stages of *Todarodes pacificus*, *Scomber japonicus*, *Trichiurus japonicus* using behavioral-hydrodynamic modeling approaches

W3-P1 **Atabak M. Azad**
Health effects, nutrients and contaminants availability from consumption of mesopelagic species in C57BL/6J mice

W3-P2 **Yiou Zhu**
Investigating the spatial variation in nutrient and contaminant levels of *Maurolicus muelleri* among Norwegian fjords, the North Sea and Bay of Biscay

W3-P3 **Salvador E. Lluch-Cota**
15 years of evolution of the Gulf of California small pelagics fishery MSC certification

W6-P1 **Katja Mäkinen**
Effects of maternal phenotype on egg quality in the Baltic herring at two temperatures

W6-P2 **Aarne Lauerma**
The effects of maternal thyroid hormones on the egg size, hatching success and larval properties of the Baltic herring (*Clupea harengus membras*) in the Baltic Sea

W6-P3 **Isabel Riveiro**
Drivers of the short-term changes of reproductive potential in *Scomber scombrus* and *Sardina pilchardus* in the North Iberian Peninsula waters